EXPLORATORY EVALUATION OF RURAL APPLICATIONS OF TELEMEDICINE

Final Report - February 1, 1997

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Executive Summary

The Office of Rural Health Policy (ORHP), Health Resources and Services Administration (HRSA), Department of Health and Human Services (HHS), and other State and Federal governmental agencies have devoted considerable financial support to rural telemedicine demonstration projects. The projects are using modern telecommunication technology to improve access to health care for rural populations. ORHP has been involved in telemedicine since 1988 and currently funds 11 telemedicine projects through its Rural Telemedicine Grant program, a large demonstration project in West Virginia, and six telehealth projects through its Rural Health Outreach grant program. One of the missing pieces in assessing the value of telemedicine was a comprehensive study of the use of this technology throughout rural America. This project, which was the first nationwide survey of rural telemedicine (not limited to interactive video), examined the status of rural telemedicine. It also developed evaluation tools and methods for agencies and individual programs to use in assessing the contribution of telemedicine to rural health care delivery. As such, this study represents an early snapshot of a technology that is expanding rapidly both in technical capabilty and potential applications for health care.

> Rural Telemedicine is in the earliest stages of development, but is expanding quickly. More than 40 percent of the telemedicine programs surveyed had been providing teleconsults for one year or less. Networks had an average of 9.3 facilities participating and many planned to expand. By the end of 1996, networks expected to have an average of 13 participatings sites.

> By the end of 1996, nearly 30 percent of rural hospitals will be using some sort of telemedicine technology to deliver patient care. Of these, 68 percent will offer only teleradiology.

> Age of the telemedicine system and receipt of Federal funding were all positively and significantly associated with total utilization of the telemedicine system (clinical and nonclinical sessions combined). The strongest association was between utilization and age of the system—as facilities gain experience with telemedicine, utilization increases.

> Some clinical applications appear to gain earlier acceptance in telemedicine than others. Radiology and cardiology were the most common clinical applications reported, followed by orthopedics, dermatology, and psychiatry. The most common nonclinical applications were education, administrative meetings, and demonstrations of the system to health care personnel.

The Exploratory Evaluation of Rural Applications of Telemedicine was conceptualized by ORHP and conducted by Abt Associates, Inc. assisted by the University of Colorado. The objectives of the study included:

> Determining the current status of telemedicine in rural health care with respect to the number and types of systems in operation, levels of technology employed, types of specialty services provided, utilization of services, costs, and patient and provider acceptance.

Exploring the effects of telemedicine on access to care, practitioner isolation, and the development of health care networks.

Exploring the organizational factors (at facility, network, community and State levels) that aid or impede the successful development and implementation of telemedicine systems.

Developing, testing, and refining data collection instruments that may be used in subsequent evaluation efforts.

The study design specified by ORHP included the following activities:

Nationwide survey of all rural hospitals to identify those actively using telemedicine (summer 1995)

Detailed follow-up survey of participants and their affiliates to describe uses of telemedicine; equipment and transmission media in use; funding sources and costs of telemedicine installations; volume of care being provided and volume of nonclinical uses of the systems; and use of telemedicine to fill gaps in specialty access in remote rural areas (Dec. 1995-Jan. 1996).

Intensive site visits at four rural telemedicine programs to investigate issues not readily studied via a survey and to provide the context for the survey data.

The screening survey was mailed to all 2,472 non-Federal U.S. hospitals that are outside metropolitan areas, as defined by the U.S. Census. Those that did not respond were interviewed via telephone. The final response rate was 95 percent. All those who reported that they had some form of telemedicine capability, and all the telemedicine affiliates they named, became the sample for the follow-up survey. Affiliates included metropolitan medical centers, rural clinics, mental health centers, and nursing homes. Each target respondent received two instruments in the mail: one for programs that do only teleradiology and a longer questionnaire for those who have other telemedicine applications available beyond radiology. Respondents were asked to select, complete and return the appropriate questionnaire. Again, nonrespondents were interviewed by telephone. The telephone follow-up portion of the sample were interviewed using an abbreviated instrument: they were not asked to obtain information from administrative or financial records because this is difficult to do in the course of a telephone interview. From the group of 558 active rural telemedicine sites and their affiliates, 499 (89 percent) completed the follow-up survey.

The very high overall response rates were accompanied by significant item nonresponse on some survey questions. The most problematic were questions about the precise equipment in use (e.g., resolution of monitors), about billing practices, and about reimbursement for telemedicine sessions. Questions about the number of sessions and the percent that was for clinical vs. nonclinical purposes also appeared to be difficult for many sites to answer, largely because they did little session-level data collection beyond simple counts. The final chapter of this report recommends "model" data collection tools, an encounter session form which could be aggregated annually (or more often), and a facility-level survey which could be conducted annually.

The following are additional key findings from the survey efforts and the case study investigations:

Telemedicine networks were complex, with an average of four spoke sites, two hubs, and four facilities that both provided and received consults.

Many rural hospitals were taking full advantage of the available technology. The equipment base was large, sophisticated, and growing quickly. Most rural telemedicine sites (excluding those doing only teleradiology) offered full-motion interactive video for live interviews, meetings, and educational sessions.

Despite the growth and expansion of this technology, the cost of telemedicine remained high. The average equipment purchase, excluding switches and new lines, ranged from $134,378 for spoke sites to $287,503 for hub sites. Reported annual transmission costs were also high, ranging from an average of $18,573 for spokes to $80,068 for hubs.

Utilization was low in the first years of most rural telemedicine programs. The average number of total sessions per month (clinical and nonclinical combined) was 24, with a median of 11. The median or typical telemedicine facility was conducting approximately one clinical session per week and 1-2 nonclinical sessions per week in early 1996.

High costs, combined with low utilization in the early years of operation, yielded high unit costs. A teleconsult cost the median or typical hub site $1,181, while the median spoke site spent $476 per consult, exclusive of any reimbursement to clinicians.

Federal and State grants were common sources of direct funding for telemedicine programs, and the majority of sites also received hospital financial support. Third-party reimbursement for telemedicine was elusive: fewer than 25 percent of hub facilities had successfully negotiated payment with insurance carriers and many had not yet undertaken such negotiations.

Lack of reimbursement, lack of clinical standards, scheduling, and time commitment remain challenges to further development and use of rural telemedicine.

The findings of this study confirmed many issues previously identified in grant projects relating to organizational challenges and barriers to expansion. At the same time, the survey pointed out some new developments in the field. First, most of the surveyed programs were quite new. This may in part explain the relatively low utilziation figures reported on the survey, and the high resulting unit costs. It is important to note that those systems able to survive and expand experience higher utilziation after the second year of operations. It is also clear that more rural hospitals were turning to telemedicine as a tool for improving health care delivery, despite the fact that there is limited reimbursement for these services from third-party payers.

1.0   Introduction and Statement of Purpose

Rural telemedicine takes many forms, but all involve the use of telecommunications to connect rural patients' primary care practitioners with specialists in distant medical centers. During the past 10 years, the transmission of medical information via telecommunications systems has become more reliable and widespread. Technologies include video-conferencing and diagnostic equipment that can transmit digitized data or compressed video over wide-area networks. The Office of Rural Health Policy (ORHP), Health Resources and Services Administration (HRSA) in the U.S. Department of Health and Human Services and other State and Federal governmental agencies have devoted considerable grant support to rural telemedicine programs, with the goal of improving access to medical care for rural populations and taking advantage of the evolving national information infrastructure to improve the delivery of services. After a few years of such funding, this project was initiated to determine the current status of rural telemedicine and to develop evaluation tools and methods for agencies and individual programs to use in future assessments of the contribution of telemedicine in rural health care delivery.

The Exploratory Evaluation of Rural Applications of Telemedicine was conceptualized by ORHP and conducted by Abt Associates Inc., assisted by the University of Colorado. The objectives of the study included:

> Determining the current status of telemedicine in rural health care with respect to the number and types of systems in operation, levels of technology employed, types of specialty services provided, utilization of services, costs, and patient and provider acceptance.

> Exploring the effects of telemedicine on access to care, practitioner isolation, and the development of health care networks.

> Exploring the organizational factors (at facility, network, community and State levels) that aid or impede the successful development and implementation of telemedicine systems.

> Developing, testing and refining data collection instruments that may be used in subsequent evaluation efforts.

The study design specified by ORHP included the following activities, discussed in detail in the following chapters:

> •   Nationwide survey of all rural hospitals to identify those actively using telemedicine

> •   Detailed follow-up survey of participants and their affiliates to describe the uses of telemedicine; the equipment and transmission media in use; funding sources and costs of telemedicine installations; volume of care being provided and volume of nonclinical uses of the systems; and the use of telemedicine to fill gaps in specialty access in remote rural areas

> •   Intensive site visits at four rural telemedicine programs to investigate issues not readily studied via a survey and to provide the context for the survey data.

The study data collection began in the summer of 1995 with a screening survey of all U.S. rural hospitals. The following winter, a detailed follow-up survey was completed and in the spring of 1996 four site visits were conducted. This report contains complete findings from all three data collection activities.

Chapter 2.0 presents the screening survey process and findings.

Chapter 3.0 presents the data collected through the follow-up survey.

Chapter 4.0 contains information gathered during intensive site visits.

Chapter 5.0 contains recommendations for data collection instruments, future evaluation tools, and methods.

2.0   Screening Survey

The first project task was to identify all rural hospitals actively using telemedicine and their affiliates to form the sample for a detailed follow-up survey.

2.1   Process

The screening survey was conducted in June and July of 1995 (see reprint in the appendix). A one-page "screening" survey was mailed to all 2,472 non-Federal rural hospitals in the country. Rural hospitals were defined as all those located outside of Metropolitan Statistical Areas. Excluded from the survey were Federal hospitals operated by the Veterans Administration, Indian Health Service, and prisons.

The objective of this screening survey was to identify rural hospitals actively involved in telemedicine/teleradiology and to facilitate the development of a national baseline of activity. The survey asked respondents to report whether a functioning system was in place at their facilities. A very broad definition of telemedicine/teleradiology was used: anything more sophisticated than a telephone and fax machine. If a system was in place, the respondent was asked to report the number of consultations occurring over that system during the preceding two months (roughly June and July, 1995); how long the system had been in active use; and what role the hospital played in the telecommunications network (hub, spoke, or both). If a hospital did not have a telemedicine/ teleradiology system in place, the respondent was asked to report whether such a system was being developed for future use, and if so, when it would be actively used for patient care. All respondents were asked to identify other providers actively involved in telemedicine/teleradiology: those in their network and those otherwise known to the respondent. The expectation was that the rural hospitals answering the screener survey would identify their urban hub partners.

The screener survey was initially administered as a mail questionnaire, but was also administered by phone during a follow-up phase. The initial mail and fax response rate was 38.3 percent.   Telephone interviews were completed with 57.4 percent of rural hospitals, for a final response rate of 95.7 percent (2,336) of all non-Federal rural hospitals.

2.2   Findings

Among those responding, 416 (17.6 percent) reported telemedicine/teleradiology activity and over 530 more had plans to begin programs during the next few years.[1]

Penetration of telemedicine varied according to the geographic region of the country. The highest rate of telemedicine involvement among rural hospitals was in the mountain region (23 percent) and lowest in the mid-Atlantic region (8.5 percent) (see map). Note that some regions have few rural hospitals (e.g., New England).

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[1]   For further information pertaining to the analysis of these survey data see A. Hassol, G. Gaumer, J. Grigsby, C.L. Mintzer, D.S. Puskin, and M. Brunswick. 1995. "Rural Telemedicine: A National Snapshot."

Percent of Rural Hosp

Using Telemedicine, by

22%   23%   19%   21%

20%   8%

14%   10%   17%
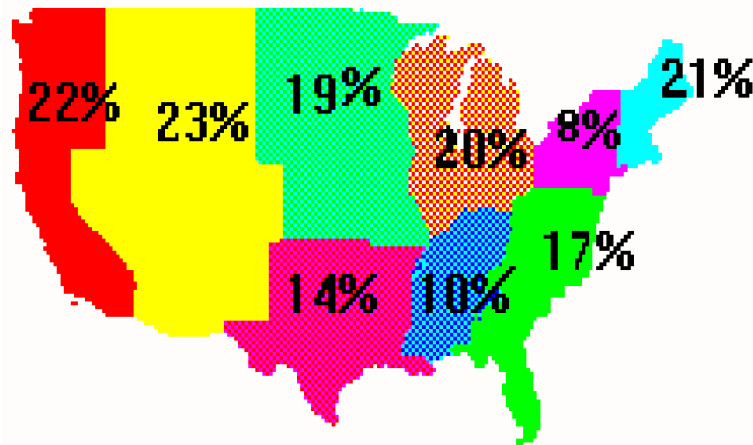
Rural communities were categorized on the basis of a classification system developed by the U.S. Department of Agriculture. Based on 1990 census data, all counties in the United States are classified into 10 distinct categories of rural intensity: four categories for urban counties and six for rural counties. The penetration of telemedicine by rural county type appears in exhibit 2.1.[2] [3]

Hospitals in more populous rural counties adjacent to metro areas were less likely to have telemedicine than hospitals in other rural places. It could be that access problems were not perceived to be as severe in counties adjacent to metro areas because patients can more readily travel for specialty care and physicians can travel to conduct regularly scheduled clinics. The cost of laying new telecommunications lines is generally greater in more remote (i.e., nonadjacent) counties, making the penetration of telemedicine in such counties even more impressive.

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[2] Butler M. and Beale C. *1993*. "Rural-Urban Continuum Codes for Metro and Nonmetro Counties." U.S. Dept. of Agriculture.

[3] Note, however, that many counties not defined as Metropolitan Statistical Areas contain a population cluster of sufficient density (towns with populations >2,500) as to be considered urban. Thus, although a county does not meet the Census Bureau's definition of an MSA, some of the inhabitants do live in urban settings.

Exhibit 2.1
Percentage of Rural Hospitals Using Telemedicine,
by Rural Intensity of County

Rural Intensity Category	Percent of responding hospitals in rurality category	Percent in category with telemedicine
Large, Adjacent: urban population of 20,000 or more, adjacent to a metro area	11.07	11.07
Large, Nonadjacent: urban population of 20,000 or more, not adjacent to a metro area	9.43	17.94
Medium, Adjacent: urban population of 2,500 to 19,999, adjacent to a metro area	29.08	15.99
Medium, Nonadjacent: urban population of 2,500 to 19,999, not adjacent to a metro area	31.78	20.88
Small Adjacent: completely rural or <2,500 urban pop., adjacent to a metro area	4.56	17.59
Small, Non-adjacent: completely rural or <2,500 urban pop., not adjacent to a metro area	13.19	17.95
Unknown/blank	.89	23.81
All respondents		17.58

Exhibit 2.2
Percentage of Rural Hospitals Using
Telemedicine, By Bedsize

Bedsize	Percent of Responding Hospitals in Bedsize Category	Percent in Category with Telemedicine
<25 (n=140)	5.92	20.00
25-49 (n=669)	28.28	17.79
50-99 (n=813)	34.36	18.33
100-199 (n=813)	21.72	17.32
200-299 (n=144)	6.09	12.50
300-399 (n=48)	2.03	18.75
400-499 (n=10)	0.42	10.00
500+ (n=28)	1.18	10.71
All Respondents (n=2,336)	100.00	17.58

Exhibit 2.2 indicates the availability of telemedicine by hospital bedsize in mid-1995. Approximately 69 percent of rural hospitals had fewer than 100 beds, and 56 percent of these hospitals had telemedicine programs. The smallest hospitals, although few in number, were the most likely to have telemedicine/teleradiology (20 percent). The few rural hospitals with more than 400 beds were less likely to have telemedicine.

Responding hospitals were asked how long their telemedicine programs had been providing patient care.

Sixty percent of rural telemedicine/teleradiology programs had been initiated in the last three years (about 30 percent in the past year).

A total of 303 rural hospitals reported plans to start telemedicine or teleradiology programs and had determined a specific start date. Of these, 261 planned to start their programs by the end of 1996.

These new programs, added to the 416 that already exist, would bring the total to nearly 29 percent of rural hospitals by the end of 1996. An additional 213 rural hospitals were considering telemedicine/ teleradiology but had not progressed sufficiently to specify a starting date.

2.3   Usefulness of Data Collection

The screener survey fulfilled its objective of identifying rural hospitals with telemedicine/ teleradiology programs. In retrospect, it would have been extremely useful to ask whether each hospital's program was teleradiology only, or included other telemedicine services. This would have made the conduct of the follow-up survey less complicated.

By asking each respondent for the names of others in their telemedicine networks, analysts expected to be able to group respondents into their respective telemedicine networks, to perform network-level analyses. Responses were grouped as best possible into networks, but nearly every respondent would need to be contacted again in order to assemble networks. This was beyond the scope of this project; therefore, network-level analyses were not possible.

There were probably a number of reasons that data were incomplete and did not permit network-level analyses. First, most respondents identified a couple of telemedicine partners, but not the complete composition of their network. For example, only one of the ORHP grantee networks' hubs sent the entire list of spoke facilities in their network, and none of the spokes of even that network provided complete information. The inability to provide complete lists of network participants may be because some spoke respondents simply did not know the full array of facilities in their network. Since ORHP's design began with a survey of rural hospitals, many hubs were not surveyed in the screener; surveyors therefore probably "missed" the best-informed respondents who might have been able to send a list of the entire composition of the network. In addition, there were many facilities, particularly using teleradiology, that were not part of a dedicated network but rather used their equipment to connect to whomever they needed for a particular purpose. (This is the model in parts of Iowa, for example.)

In the future, it would be useful to find another method to obtain complete information and group respondents, to the extent possible, into networks. Others have tried this by a sequence of phoning a telemedicine participant and asking for the "hub" and then asking the hub for each participant in the entire network. To the extent that the hub respondent has complete information about a dedicated network, this works well. This is a complex and costly survey strategy, however, and may not be warranted for the hundreds of teleradiology programs. It may be more useful to perform this exercise for those networks using other telemedicine applications. And, as connectivity/standardization improves, dedicated networks may become less common and more fluid arrangements may prevail, making this a nonissue.

Finally, when asked about the number of patient consults, over 100 respondents on the first survey either did not respond or responded "0", although they also responded that they had active telemedicine programs. These respondents were retained for the follow-up survey because either their status was unknown (they reported nothing about volume) or they were about to become operational and might have data to report for the follow-up survey. Analysts learned during the follow-up survey that over 50 of these hospitals were not actually using telemedicine/teleradiology for patient care, even by the time the second survey was conducted. Their response on the first survey had been optimistic, at best.

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3.0 The Follow-Up Survey

In November 1995 a second survey effort was undertaken to gather in-depth information from those facilities the screener survey identified as having active systems. Facilities identified through the screener survey were mailed two in-depth questionnaires. One questionnaire was a teleradiology survey for facilities *only* providing teleradiology services. The other questionnaire was a telemedicine survey for facilities actively using their systems for clinical applications other than (or in addition to) teleradiology. Because the surveys differed between two types of facilities, this report distinguishes between facilities that only use teleradiology—*Teleradiology Only Facilities*—and those that use their networks for other, nonradiology clinical applications. These latter respondents are referred to as *Telemedicine Facilities*. Telemedicine, therefore, refers to respondent sites that generally offer a broader array of clinical applications and *does not* include those facilities that only offer teleradiology services.

Respondents were asked to answer only the questionnaire most applicable to their system. (It is possible that some poorly informed respondents returned an incorrect version of the survey.) The telemedicine survey asked respondents to provide information on the characteristics of the facility such as its type (hospital or clinic), role in the communications network (hub, spoke, or both), number of health professionals on staff and using the telemedicine system by profession, distance to the nearest acute care general hospital, local availability of different types of specialities, and typical participants during a telemedicine session. The survey also obtained information about the organization and implementation of the system, including which specialities use it and how many consults occurred during the previous two months overall (by speciality and by clinical function); the equipment and technologies used; costs and financing; clinical accessibility; and confidentiality and security.

The teleradiology survey principally requested data on equipment and technologies in use. This survey also asked about the facility's plans to expand the system to nonradiology clinical uses.

Both surveys were initially mailed to identified facilities. As in the first screener survey, those facilities not returning a survey were contacted and an attempt made to administer the appropriate questionnaire by phone. The telemedicine phone instrument was somewhat abbreviated. For example, the phone version only asked the respondent to report the total number of telemedicine consults over the past two months; the mail version requested that the number of consultations be disaggregated by type (number of consultations given, requested, and number of nonclinical sessions), by speciality (cardiology, dermatology, etc.), and by clinical function (emergency, routine, etc.).

3.1 Survey Response Rates

Exhibit 3.1.0 presents a summary of the survey administration. The 416 hospitals that indicated telemedicine/teleradiology activity in the screener survey were mailed the second set of surveys requesting more in-depth information about their programs. This second set of surveys was also

Exhibit 3.1.0
Size of Sample Contacted and Ineligibles

Eligibility Status	Rural Hospitals Identified as Having Active Systems[a]		Other Providers Identified as Having Active Systems[b]		Total	
	Number	Percent	Number	Percent	Number	Percent
Mailed Surveys	416	100.0	281	100.0	697	100.0
Determined to be Ineligible	63	15.1	76	27.0	139	19.9
Do Not Have a System	63	15.1	66	23.5	129	18.5
Other	0	0.0	10	3.5	10	1.4

[a] From sample of rural hospitals answering the screening survey.

[b] Other providers identified by rural hospitals answering the screening survey.

mailed to partners identified by the respondents to the first survey, but not included in this initial survey. These surveys were mailed to 281 partners for a total of 697 facilities contacted.[4]

Analysts determined that 139 (20 percent) of providers contacted were actually ineligible for this survey (see exhibit 3.1.1). The majority of ineligible providers (128) indicated that either they did not have telemedicine/teleradiology or were not yet using their system. About half of these ineligibles (63) were part of the initial sample of 416 rural hospitals, which suggests that the first survey was a successful, but not perfect, screener. The other 10 ineligibles were either duplicates, or contact information was incomplete and they could not be located. The last ineligible case completed the telemedicine survey, but the respondent was a trade association, not a medical care provider.

Exhibit 3.1.1
Size of Eligible Sample and Response Rates

Eligibility Status	Rural Hospitals Identified as Having Active Systems[a]		Other Providers Identified as Having Active Systems[b]		Total	
	Number	Percent	Number	Percent	Number	Percent
Eligible Sample	353	100.0	205	100.0	558	100.0
Respondents	324	91.8	175	85.4	499	89.4
Refusals	21	5.9	15	7.3	36	6.5
Lost to Follow-up	8	2.3	15	7.3	23	4.1

[a] From sample of rural hospitals answering the screening survey.

[b] Other providers identified by rural hospitals answering the screening survey.

Eliminating the 139 ineligible cases left an eligible sample of 558. Of these, 353 (63 percent) were rural hospitals identified through the screener survey and 205 (37 percent) were other types of health

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[4]   The first survey identified an additional 278 providers. The other three heard about the survey effort and asked to be included.

care providers—generally "partners" of the responding rural hospitals. Based on this eligible sample, the response rate to the followup survey was 89 percent. The response rate within the initial sample of 353 eligible cases who responded to the screener was 92 percent (see exhibit 3.2). The response rate was 85 percent among those named as telemedicine partners. Since these partners were referred by other hospitals and contact information provided was less accurate, it is an extremely high response rate. The majority of the nonrespondents (36) were refusals. The other 23 non-response cases were lost to follow-up (i.e., not returned as undeliverable, not completed and returned, and no one could be located via directory assistance for telephone interviewing).

Exhibit 3.2.0
Distribution of Respondents by Survey Instrument

Eligibility Status	Rural Hospitals Identified as Having Active Systems[a]		Other Providers Identified as Having Active Systems[b]		Total	
	Number	Percent	Number	Percent	Number	Percent
Respondents	324	100.0	175	100.0	499	100.0
Telemedicine Survey	97	29.9	62	35.4	159	31.9
Mail	74	22.8	33	18.9	107	21.4
Phone	23	7.1	29	16.6	52	10.4
Teleradiology Only Survey	227	70.1	113	64.6	340	68.1
Mail	106	32.7	31	17.7	137	27.4
Phone	121	37.3	82	46.9	203	40.7

[a] From sample of rural hospitals answering the screening survey.
[b] Other providers identified by rural hospitals answering the screening survey.

Among the 499 respondents, 159 (32 percent) completed the telemedicine survey, of which 67 percent answered the mail version. Another 340 (68 percent) completed the teleradiology survey, 40 percent of whom answered the mail version. In both surveys the administration of the survey instruments over the phone significantly increased survey response rates from lows of 40 to 60 percent, up to 85 percent or better.

There was considerable variation in the types of individuals completing the surveys. For the entire sample (telemedicine and teleradiology), the most frequent type of respondent had the title "administrator" (13 percent of 499 respondents). Other common respondents were director of radiology (8 percent), radiologist (5 percent), radiology manager (4 percent), and CEO (3 percent). Business managers, directors of diagnostic imaging, doctors, nurses, and site coordinators also answered the surveys. When respondents were grouped by type, 44 percent were administrators directly associated with telemedicine or teleradiology; for example, chief of radiology, director of telemedicine and teleradiologist. Another 41 percent were classified as individuals in general administration, such as the CEO, director of education and outreach specialist. The other respondents were classified as clinicians; either general clinicians (2 percent), such as doctors, pediatricians, and R.N.s, or telemedicine/teleradiology clinicians (12 percent), chief x-ray technician, telemedicine R.N., and staff radiologist.

The Telemedicine survey, regardless of whether it was administered over the phone or by mail, was more likely to be completed by a general administrator (60 percent) relative to the Teleradiology Only surveys (31 percent), which were more likely to be completed by a telemedicine/teleradiology administrator (50 percent compared to 31 percent for the telemedicine survey). The smaller rural spokes were more likely to rely on a general administrator to complete the survey (68 percent) relative to the larger urban hubs (55 percent), which were more likely to have a telemedicine/teleradiology administrator complete the surveys (39 percent compared to 22 percent among spokes). This four-way classification—general administrator, telemedicine/teleradiology administrator, telemedicine/teleradiology clinician, and other clinician—is crude at best. The positions of chief of radiology or telemedicine manager are likely to vary across different hospitals, particularly between small and large facilities, so that at one facility these individuals may be full-time administrators while at another facility they are primarily clinicians. In addition, for the mail surveys it is possible that the survey instrument was passed among several informed staff members, so that the individual listed as the respondent may not reflect all sources of information.

3.2   Item Nonresponse

Nonresponse is always a concern in the collection of survey data. As noted in the previous section, some proportion of the sample does not respond to the survey; among those responding, not all answer each question posed, resulting in item nonresponse.

Item nonresponse is important for two reasons. First, an objective of the survey was to determine whether respondents were capable of answering particular questions. Because the current generation of telemedicine and teleradiology projects are relatively new, there were no previous national, in-depth surveys to use in designing instruments. Facilities might not be able to answer all questions because few facilities are required to collect data on their telemedicine activities. Exhibit 3.2.1 shows the extent to which telemedicine facilities collect data.[5] Twenty-three percent reported that no one in their network collected data on telemedicine consults and sessions. More than 60 percent collected information on the date of the consult or reason for the visit. Since the surveys were administered either as a mail instrument or over the phone, it is possible to make some preliminary determination about how the two types of survey administration methodologies might have influenced reporting rates. (This is explored below.)

Second, as with any survey, it was important to determine the extent of censoring within particular data items. If data are simply unavailable for reasons that are unknown to the analyst and the underlying reason for a nonreport is *not systematic* across respondents (i.e., data are randomly missing), one may simply ignore the problem as long as there is no concern with the efficiency of estimates. However, if data are *systematically* missing (i.e. nonrandom), the observed data are censored and estimates may be biased.

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[5]   These questions were not part of the survey for teleradiology-only facilities.

Exhibit 3.2.1
Type of Data Collected by Telemedicine Facilities (N = 159)

	Number	Percent
No Telemedicine Data Routinely Collected	37	23.3
Data Collected[a]		
Consult Date	109	68.6
Duration of Consult	85	53.5
Type of Peripherals Used	59	37.1
Reason for Consult	102	64.2
Diagnosis	87	54.7
Physician Names	107	67.3
Specialty Area	97	61.0
Patient Data	86	54.1
Patient Satisfaction	81	50.9
Provider Satisfaction	85	53.5
Information about Patients who Refuse Telemedicine	26	16.4
Information from Practitioners who Rarely Use Telemedicine	18	11.3
Information about each Occasion of Non-Clinical Use	79	49.7
Benefits of Telemedicine	80	50.3
Participating in Systematic Research on Medical Efficacy	62	39.0
Participating in Health Services Research on Telemedicine	45	28.3

[a] Due to multiple responses, percentages sum to more than 100 percent.

Appendix A1 presents item nonresponse rates for each question in each survey instrument. The first column of the table indicates the question number from the survey. If two different question numbers are indicated, the first one corresponds to the Telemedicine survey and the second to the Teleradiology Only survey. A descriptive title for each question is in the second column. Columns three and four present item nonresponse rates for the two Telemedicine surveys (mail and phone) while columns five and six present mail and phone item nonresponse rates for the Teleradiology Only surveys. When a question was not asked in a survey instrument, N/A (for Not Applicable) appears entered in the table. (As discussed earlier, the telephone version of each instrument was abbreviated to enhance response rates.) Skip patterns appear at several points in the surveys, and these patterns are incorporated when calculating the nonresponse rates. Questions affected by these patterns and the resulting size of subsamples are footnoted in the table.

Numerous questions on the survey instruments were multiple choice. The nonresponse rates for these questions reflect those respondents that did not mark *any* of the possible responses. Also, several multiple choice questions had multiple sections. An example is question five in the Telemedicine survey. The respondent was first asked to indicate the number of staff by professional category (e.g., primary care doctors, specialists, registered nurses, etc.) practicing in the facility and then asked how many within each professional category have used the telemedicine system for patient care. In appendix A1, an item nonresponse rate is shown for the number practicing at the facility, the number who have used the telemedicine system, and then an overall nonresponse rate for those who did not respond to any part of the question.

Throughout the majority of the Telemedicine survey, nonresponse rates tended to be higher among those answering the mail instrument as compared to the phone respondents. A similar but less consistent pattern appears in responses to the Teleradiology Only instruments. Phone interviews

allow for probes that can decrease item nonresponse rates, but may increase errors in reporting. Because the study did not include a records check to verify data, the extent of the trade-off between improved item response rates and increased reporting errors is unknown.

High rates of nonresponse generally occurred in three different areas of the surveys:

- Substantial nonresponse rates occurred when respondents were asked to report the facility's American Hospital Association (AHA) identification number and Medicare provider number (36 to 96 percent nonresponse). Perhaps reporting rates were poor because the surveys were not completed by someone in the billing or administrative records offices. Unfortunately, the high nonresponse rates prohibit analysts from merging survey data with AHA or Medicare data.

- The technical questions about monitor resolution, gray-scale, and the resolution of digitization systems also had extremely high rates of nonresponse, 36 to 59 percent. Perhaps the person filling out the survey did not have this information readily available, particularly when answering the survey over the phone.

- High nonresponse rates occurred when respondents were asked to report the costs of the system, particularly annual transmission costs and the number of FTEs devoted to operating the system. It is not uncommon for equipment at rural facilities to be gifted or loaned, or for transmission costs to be covered by the urban "hub" facility. For this reason, nonresponse rates for initial equipment costs and yearly transmission costs were higher among spokes, 37 to 59 percent respectively, than among hubs, 12 to 46 percent.

In addition to the general challenges noted above, respondents to the *mailed* Telemedicine survey had problems reporting billing information. Approximately 33 percent did not report who submits the bill to insurers, and also did not report that a bill is not submitted—they provided no information on this question. Among those that reported that bills are submitted, 46 percent were unable to report the basis used for charges. The majority of respondents to the Teleradiology Only survey (54 to 59 percent) were not able to report the types of telecommunication services that were available for the transmission of data and images. Many of these systems probably use Plain Old Telephone (POTS) lines and respondents were confused by the question because they are uninformed about other transmission services. Respondents to the mailed Teleradiology Only survey who reported plans to add other telemedicine applications had difficulty reporting the types of services, technologies and equipment that the facility will add.

Appendix A1 indicates that nonresponse was also high on other questions; however, in some cases this reflects more than an inability (or refusal) to answer a question. For example, the nonresponse rate for the date of the first patient consult appears high because it reflects facilities that did not respond *and* facilities that had not yet started using their system for patient care. Although the intention was to survey only facilities using telemedicine to provide patient care, some that were not yet providing care were included in the sample (by responding incorrectly to the first survey) and responded to the second survey. Similarly, respondents were asked to report the number of facilities in their network and the number of facilities expected to join the network in the next 12 months. The

nonresponse rate for the number expected to join, which ranges from 25 to 38 percent, reflects nonresponse *and* cases where the network does not plan to expand. When respondents to the Telemedicine survey were asked to report which services were reimbursed (question 30), between 40 and 54 percent did not respond. Nonrespondents in this case are those who were unable or refused to answer *and* those that had not yet negotiated coverage for telemedicine services and possibly did not yet submit bills to insurers.

3.3   The Characteristics of Telemedicine

3.3.1   Characteristics of Respondents

Ninety-four percent of respondents reported that their facilities were hospitals. The other six percent were principally clinics, physician offices, and mental health facilities. Based on data from the 1995 SMG Abridged Hospital Database, the majority of hospitals were either non-Federal government facilities run by the county or hospital district or not-for-profit institutions.[6] Between 19 and 25 percent reported a medical school affiliation.[7]

Hospitals operating telemedicine systems were evenly divided between small facilities of 50 or fewer staffed beds (33 percent), medium-sized facilities between 50 and 250 beds (30 percent), and large facilities of more than 250 staffed beds (24 percent). Teleradiology Only facilities were more likely to be medium-sized hospitals (46 percent have between 50 and 250 beds) and less likely to be large facilities (14 percent have over 250 beds).[8]

Another indicator of size is staff size. Telemedicine respondents to the mail survey provided information about the size of their clinical staff by job classification. The distribution of the size of clinical staff reflects the large variation seen in hospital size. Exhibit 3.3.2 shows that it was not unusual for telemedicine facilities to have less than five primary care physicians (34 percent), and approximately 17 percent had only one or two primary care physicians. Conversely, approximately four percent reported in excess of 100 primary care physicians with staff privileges. The distribution of specialists was even wider, with 12 percent of respondents reporting no specialists at all and nine percent reporting 100 or more specialist physicians practicing at their facilities. The number of other nonphysician clinicians on staff ranged from none (9 percent) to 100 or more (3 percent).

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[6]   The SMG data were merged to the survey data using the zip code and institution name.

[7]   Among the telemedicine facilities associated with a medical school, 55 percent are hubs.

[8]   Among the 6,539 AHA registered hospitals in 1992, the average number of beds per hospital was 180.

Exhibit 3.3.1
Characteristics of Facilities Operating Telemedicine and Teleradiology Systems

	Telemedicine		Teleradiology	
	Number	Percent	Number	Percent
Total	159	100.0	340	100.0
Type of Facility				
Hospital	145	91.2	323	95.0
Clinic	2	1.3	4	1.2
Physician Office	4	2.5	11	3.2
Mental Health Center	4	2.5	0	0.0
Other	4	2.5	2	0.6
Ownership Type[a]				
Governmental, Non-federal	57	35.8	154	45.3
Not for Profit	80	50.3	138	40.6
For Profit	1	0.6	19	5.6
Missing	21	13.2	29	8.5
Affiliated with a Medical School	40	25.2	65	19.1
Size[a]				
Staffed Hospital Bed Size				
50 or less	53	33.3	110	32.4
51 - 100	22	13.8	82	24.1
101 - 250	25	15.7	73	21.5
251 or more	38	23.9	46	13.5
Not a Hospital	14	8.8	17	5.0
Missing	7	4.4	12	3.5
Mean	156 beds		137 beds	
Median Annual Number of Admissions	1,639 admissions		1,581 admissions	
Median Average Daily Census	52		36	
Urban - Rural Continuum[b]				
Metro	44	27.7	83	24.4
Nonmetro				
Adjacent to Large Metro Area	6	3.8	18	5.3
Adjacent to Small Metro Area	32	20.1	75	22.1
Not Adjacent to Metro Area and Has a City of at Least 2,500	61	38.4	126	37.1
Not Adjacent to Metro Area and Has a City of Less Than 2,500	16	10.1	38	11.2
Distance to Nearest General Hospital	48 miles		N/A	

[a] Data from the 1995 Abridged Hospital Database, SMG Marketing Group, Inc.

[b] County classification developed by the Rural Economy Division of USDA's Economic Research Service and based on the facility's location.

Exhibit 3.3.2

Number of Clinical Personnel
Among Spoke and Dual Hub/Spoke Respondents
to the Mailed Telemedicine Survey

	Number	Percent
Total	77	100.0
Number of Primary Care Physicians		
1 to 2	13	16.9
3 to 4	13	16.9
5 through 14	28	36.4
15 or More	13	16.9
Missing	10	13.0
Number of Specialist Physicians		
None	9	11.7
1 to 2	13	16.9
3 to 4	3	3.9
5 through 14	16	20.8
15 or More	17	22.1
Missing	19	24.7
Number of Other Clinicians[a]		
None	9	11.7
1 to 2	27	35.1
3 to 4	9	11.7
5 through 14	12	15.6
15 or More	9	11.7
Missing	11	14.3

[a] Includes physician assistants, nurse practitioners, nurse midwives, mental health practitioners, and an 'other' category.

A clear relationship exists between the size of the facility and the characteristics of the telemedicine system. Most small hospitals, 91 percent, typically requested consultations from others (see exhibit 3.3.3).[9] Their telemedicine systems were new (had been in place for one year or less), or if older had been used for only a few clinical applications (less than four different applications). Presumably, these small facilities faced constrained access to specialty care, and telemedicine may be one tool for addressing this problem. Large facilities primarily served as hubs or hubs/spokes in the system, providing consultations to others via telemedicine (84 percent). Approximately 63 percent of these larger facilities had been using telemedicine for more than one year and more than half had used it for at least four different clinical applications, reflecting their many available specialists.

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[9] Only the Telemedicine surveys requested the respondent to report the facility's role in the network.

Exhibit 3.3.3
Characteristics of Small, Medium, and Large Sized Facilities
Operating Telemedicine Systems

	Small 50 or fewer beds		Medium 51 to 250 beds		Large 251 or more beds	
	Number	Percent	Number	Percent	Number	Percent
Total	53	100.0	47	100.0	38	100.0
Median Number of:						
Primary Care Physicians	6.0		9.0		17.5	
Specialty Physicians	2.5		11.0		80.5	
Other Clinicians[a]	2.0		2.0		28.0	
Role in Network						
Spoke	31	58.5	28	59.6	6	15.8
Hub & Spoke	17	32.1	9	19.1	15	39.5
Hub	5	9.4	10	21.3	17	44.7
Missing	0	0.0	0	0.0	0	0.0
Scope of System[b]						
Start-Up	26	49.1	14	29.8	14	36.8
Narrow Clinical Application	15	28.3	11	23.4	11	28.9
Broad Clinical Application	9	17.0	16	34.0	13	34.2
Missing	3	5.7	6	12.8	0	0.0

[a] Includes physician assistants, nurse practitioners, nurse midwives, mental health practitioners, and an "other" category.

[b] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.

A facility's location was also related to its role in a telemedicine network and the scope of its applications. Exhibit 3.3.1 indicates that approximately 28 percent of telemedicine facilities were located in urban metro areas. Reflective of their wealth of available specialists, these urban sites primarily served as hubs and provided teleconsults to others (82 percent). More than half of these urban facilities had been operating their telemedicine system for more than one year as of January 1996; 60 percent had at least four different clinical specialities using the system (see exhibit 3.3.4).

One quarter of telemedicine respondents were located in nonmetro (i.e., rural) counties adjacent to metro areas. Almost all of these facilities requested teleconsults rather than providing them to others. It is possible that because of their close proximity to urban hospitals, facilities in these adjacent areas had working relationships with the urban hub prior to the introduction of telemedicine.

More remote rural facilities, in communities not adjacent to metropolitan areas, constituted 48 percent of our sample. These facilities typically requested teleconsults from others (83 percent), and approximately 43 percent had been operating for one year or less as of January 1996.

Exhibit 3.3.4
Characteristics of Metro and Nonmetro Telemedicine Systems

	Metro[a]		Rural Adjacent to Metro Area		Rural Remote	
	Number	Percent	Number	Percent	Number	Percent
Total	44	100.0	38	100.0	77	100.0
Role in Network						
Spoke	6	13.6	25	65.8	37	48.1
Hub & Spoke	10	22.7	7	18.4	28	36.4
Hub	26	59.1	6	15.8	12	15.6
Missing	2	4.5	0	0.0	0	0.0
Scope of System[b]						
Start-Up	17	38.6	15	39.5	33	42.9
Narrow Clinical Application	10	22.7	10	26.3	21	27.3
Broad Clinical Application	15	34.1	10	26.3	18	23.4
Missing	2	4.5	3	7.9	5	6.5

[a] County classification developed by the Rural Economy Division of USDA's Economic Research Service and based on the facility's location.

[b] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.

3.3.2 Basic Characteristics of Telemedicine

The 159 facilities using telemedicine played one of three roles within their telemedicine networks. Exhibit 3.3.5 shows that 43 percent of telemedicine respondents were spokes seeking teleconsultations from distant specialists. Spokes respondents were characteristically small (46 percent) (see exhibit 3.3.6) and located in remote rural counties not adjacent to metro areas (54 percent). Twenty-eight percent of respondents were dual hub/spoke facilities. These facilities were likely to be providing teleconsultations in some clinical specialties and requesting teleconsults in other specialties. These facilities disproportionately reported having used their system for four or more clinical applications: 40 percent compared to 27 percent of the entire sample. The final 28 percent of facilities were hubs (typically larger urban hospitals). Two-thirds of hubs were medium size or larger and 60 percent were located in metro counties.

Exhibit 3.3.5
The Basic Characteristics of Telemedicine (n=159)

	Number	Percent
Telemedicine Initiated by[a]:		
Administrators	125	78.6
Clinicians	77	48.4
Missing	2	1.3
Role in Network		
Spoke	68	42.8
Hub and Spoke	45	28.3
Hub	44	27.7
Missing	2	1.3
Current Size of Network		
4 or fewer facilities	42	26.4
5 - 8 facilities	48	30.2
9 - 12 facilities	33	20.8
13 or more facilities	25	15.7
Missing	11	6.9
Mean	9.3 facilities	
Age of System Operations in Months[b]		
0 through 12	65	40.9
12 through 24	42	26.4
25 through 36	23	14.5
37 through 48	10	6.3
More than 48	9	5.7
Missing	10	6.3
Mean	19.4 months	
Scope of System[c]		
Startup	65	40.9
Narrow Clinical Application	41	25.8
Broad Clinical Application	43	27.0
Missing	10	6.3

[a] Due to multiple responses, percentages do not sum to 100 percent.

[b] Age based on first date of system operation and January 1, 1996.

[c] Start-ups have been operating one year or less. Narrow application facilities have been operating for more than one year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.

The size of networks varied from small groups of four or fewer facilities (26 percent) to large networks of 13 or more partners (16 percent). Even though current telemedicine projects were relatively new, networks were large with an average of more than 9 partners as of January 1996, and had plans to expand to 13.3 partners by the end of 1996, an increase of 43 percent.

During site visits (see chapter 4) project staff observed the potential for tiered networks made up of urban hub partners providing specialty care to rural regional centers as well as to remote rural partners. The regional centers also have capacity to provide some specialty care to remote rural partners. Some spokes have expressed a desire to provide care and support to other near-by spokes via telemedicine technology.

Respondents reported that their systems had been in operation for an average of 19 months. Facilities that only began operations within the last year comprised 41 percent of the sample. Throughout the remainder of this chapter these new facilities are referred to as "start-ups."

Exhibit 3.3.6
The Variation in Facility Characteristics by Network Role

	Spokes		Hub & Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Size[a]						
Staffed Hospital Bed Size						
50 or less	31	45.6	17	37.8	5	11.4
51 - 100	17	25.0	2	4.4	3	6.8
101 - 250	11	16.2	7	15.6	7	15.9
251 or more	6	8.8	15	33.3	17	38.6
Missing	3	4.4	4	8.9	12	27.3
Mean	97 beds		172 beds		255 beds	
Urban - Rural Continuum[b]						
Metro	6	8.8	10	22.2	26	59.1
Nonmetro						
Adjacent to Large Metro Area	3	4.4	1	2.2	2	4.5
Adjacent to Small Metro Area	22	32.4	6	13.3	4	9.1
Not Adjacent to Metro Area	37	54.4	28	62.3	12	27.3
Scope of System[c]						
Start-Up	28	41.2	18	40.0	19	43.2
Narrow Clinical Application	19	27.9	8	17.8	12	27.3
Broad Clinical Application	13	19.1	18	40.0	12	27.3
Missing	8	11.8	1	2.2	1	2.3

a   Data from the 1995 Abridged Hospital Database, SMG Marketing Group, Inc.

b   County classification developed by the rural Economy Division of USDA's Economic Research Service and based on the facility's location.

c   Start-ups have only been operating for one year or less. Facilities with narrow application have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.

Exhibit 3.3.7
Age of System Operations - Teleradiology
Only Facilities (n=340)

	Number	Percent
Age of System in months		
0 through 12	54	15.9
13 through 24	70	20.6
25 through 36	34	10.0
37 through 48	34	10.0
More than 48	59	17.4
Missing	89	26.2
Mean	33.9 months	

Among those in operation for more than one year, 50 percent (42 facilities) had been in operation between one and two years. Teleradiology Only facilities were older and had been operating for slightly less than three years (see exhibit 3.3.7).

Telemedicine facilities more than one year old are designated here as having a narrow clinical application if teleconsults had occurred in less than four clinical specialties, or as having a broad clinical application if four or more different specialties had provided teleconsults. Exhibit 3.3.8 shows that broad application facilities were more likely to be dual hub/spoke sites that requested consultations in some specialities and provided consultations in other specialities. Telemedicine facilities with broader applications were older than others: almost three years compared to two years for systems with a narrower clinical experience. Sixty percent of facilities that had been operating between one and two years had a narrow range of clinical applications, whereas those operating for two or more years were more likely to have a broader set of applications (62 percent). These relationships suggest that as systems mature, the clinical application of telemedicine expands and involves more specialties.

3.3.3   Clinical Needs and the Volume and Scope of Telemedicine

<u>Clinical Needs</u>

Patients at spoke facilities potentially have the most to gain from telemedicine in terms of improved access to specialty care. Presumably their communities have few local specialists. Spoke facilities were asked to report which specialty services were available locally and which specialties were available through visiting specialists (e.g., regularly scheduled clinics). This information provided some indication of the need for telemedicine in these areas.

Exhibit 3.3.8
Variation in System Characteristics by Scope of System

	Start-Up[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Role in Network						
Spoke	28	43.1	19	46.3	13	30.2
Hub & Spoke	18	27.7	8	19.5	18	41.9
Hub	19	29.2	12	29.3	12	27.9
Missing	0	0.0	2	4.9	0	0.0
Current Size of Telemedicine Network						
4 or fewer facilities	20	30.8	9	22.0	10	23.3
5 through 8 facilities	20	30.8	9	22.0	16	37.2
9 through 12 facilities	12	18.5	10	24.4	9	20.9
13 or more facilities	9	13.8	8	19.5	8	18.6
Missing	4	6.2	5	12.2	0	0.0
Mean	9.0 facilities		10 facilities		9.7 facilities	
Age of System Operations in months [b]						
0 through 12	65	100.0	0	0.0	0	0.0
13 through 24	0	0.0	25	61.0	17	39.5
25 through 36	0	0.0	10	24.4	13	30.2
37 through 48	0	0.0	4	9.8	6	14.0
More than 48	0	0.0	2	4.9	7	16.3
Mean	8.4 months		23.5 months		32.3 months	

[a] Start-ups have only been operating for a year or less. Facilities that have a narrow application are those that have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four ore more clinical areas are defined as having a broad clinical application.
[b] Age based on first date of system operation and January 1, 1996.

Exhibit 3.3.9 shows that several specialties were not readily available in rural communities, either locally or via visiting specialists. Seventy-two percent of spoke communities had no dermatologist available locally or via visiting specialists, 62 percent were without a neurologist, 53 percent had no psychiatrist, and 51 percent had no oncologist. OB/GYN and pediatrics were also unavailable locally in 28 percent and 49 percent of spoke communities, respectively. The unavailability of these specialties may be due to sparse populations and little routine need for specialty care. However, the occasional patient who does require these specialty services could not access them locally.

Other specialties were in more plentiful local supply. There were few communities without specialists in radiology, pathology, dentistry, or general surgery. Social, therapeutic, and nutritional services were also readily available. It is important, however, to acknowledge that local specialists may not always be accessible where and when a need arises, so that even in radiology where there appeared to be good local availability, access may have been inadequate in some individual cases. In addition,

Exhibit 3.3.9
Percent of Spoke Respondents Reporting Clinical Specialty Availability (n = 68)

Specialty	Available Locally	Available Locally or Through Visiting Specialists
Cardiology	20.6	66.2
Orthopedics	29.4	67.6
Dermatology	10.3	27.9
General Surgery	72.1	89.7
Internal Medicine	64.7	75.0
Oncology	7.4	48.5
Dentistry	85.3	86.8
Pediatrics	42.6	51.5
Neurology	10.3	38.2
Ophthalmology	48.5	76.5
Nuclear Medicine	35.3	50.0
Pathology	32.4	83.8
Psychiatry	27.9	47.1
Radiology	60.3	92.6
OB/GYN	55.9	72.1
HIV/AIDS	20.6	26.5
Social Services	80.9	88.2
Therapies (PT, OT)	83.8	92.6
Nutrition Services	75.0	89.7
Substance Abuse	38.2	50.0

these data quantify shortages in general specialty areas, but not subspecialty areas such as child psychiatry.

The Volume of Teleconsultation

The data in exhibit 3.3.9 suggest that the current use of telemedicine systems to fill gaps in specialty availability could be fairly substantial. Exhibit 3.3.10 indicates, however, that volume of teleconsultation was quite low as of January 1996 and that telemedicine was probably addressing only a few needs.

Approximately 45 percent of facilities used their system eight or fewer times in any given month for any purpose (clinical or nonclinical), or no more than twice a week. Cumulatively, 68 percent used their system no more than 16 times a month, or less than once each day. Considering clinical volume separately from nonclinical, three-quarters of facilities answering the mail survey reported no more than 16 clinical consults in a given month. This very low volume may reflect the fact that 67 percent of telemedicine sites had been operational for fewer than two years (see exhibit 3.3.5), but may also indicate substantial barriers to the expansion of telemedicine (see section 4.2.4 for discussion of barriers).

Exhibit 3.3.10
The Volume of Telemedicine Facilities (n=159)

	Number	Percent
Total Reported Consults and Sessions Per Month[a]		
8 or fewer	71	44.6
8 through 16	36	22.6
16 through 24	12	7.5
24 through 32	10	6.3
More than 32	27	17.0
Missing	3	1.9
Mean	23.8 sessions/month	
Total Reported Clinical Consults Per Month[b]		
8 or fewer	70	65.4
8 through 16	12	11.2
16 through 24	4	3.7
24 through 32	4	3.7
More than 32	13	12.1
Missing	4	3.7
Mean	18.4 sessions/month	
Total Reported Nonclinical Sessions Per Month[b]		
8 or fewer	57	53.3
8 through 16	20	18.7
16 through 24	6	5.6
24 through 32	6	5.6
More than 32	11	10.3
Missing	7	6.5
Mean	13.4 sessions/month	

[a] Clinical consultations *and* nonclinical sessions; based on greatest number of consultations and sessions reported.
[b] Only the 107 mail respondents reported volume by type: clinical or nonclinical.

System volume is likely to be determined by a number of facility factors such as size of facility and maturity of the system. Exhibit 3.3.10 shows that among the low volume facilities (those reporting 16 or fewer sessions in a month), 48 percent were spokes: small facilities with a relatively small patient base. In addition, approximately 50 percent of low volume facilities were start-ups in their first year of operations.

Another 29 percent used their systems for a narrow range of clinical applications; these were newer systems relative to those with a broader base of clinical applications. Fifty-six percent of high volume facilities (those that reported more than 32 sessions in a month) had a broader base of clinical applications and had been operating over a longer period.[10]

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[10] Respondents to the phone survey were not asked to disaggregate volume by clinical and nonclinical uses.

Exhibit 3.3.11
The Variation of Network Role and Scope of System by System Volume

	Low Volume (16 or fewer consults or sessions/month)		Moderate Volume (16 through 32 consults or sessions/month)		High Volume (more than 32 consults or sessions/month)	
	Number	Percent	Number	Percent	Number	Percent
Total	107	100.0	22	100.0	27	100.0
Role in Network						
Spoke	51	47.7	8	36.4	8	29.6
Hub & Spoke	26	24.3	8	36.4	10	37.0
Hub	28	26.2	6	27.3	9	33.3
Missing	2	1.9	0	0.0	0	0.0
Scope of System[a]						
Start-up	49	45.8	9	40.9	5	18.5
Narrow Clinical Application	31	29.0	7	31.8	5	18.5
Broad Clinical Application	22	20.6	4	18.2	15	55.6
Missing	5	4.7	2	9.1	2	7.4
Age of System Operations in months[b]						
0 through 12	51	47.7	9	40.9	5	18.5
13 through 24	32	29.9	4	18.2	6	22.2
25 through 36	13	12.1	4	18.2	6	22.2
37 through 48	5	4.7	2	9.1	3	11.1
More than 48	2	1.9	2	9.1	5	18.5
Missing	4	3.7	1	4.6	2	7.4
Mean	16.5 months		22.9 months		28.4 months	

[a] Start-ups have only been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.
[b] Age based on first date of system operation and January 1, 1996.

Confirming the pattern seen in exhibit 3.3.11, spoke sites on average reported lower volume: 50 percent used their systems eight or fewer times in a month (see exhibit 3.3.12). The dual hub/spoke sites and the hub sites reported higher volumes, but 44 and 36 percent, respectively, still only used their systems fewer than nine times a month. These patterns were also true for clinical uses and nonclinical uses reported by those respondents answering the mail survey.

Exhibit 3.3.12
The Variation of Volume by Network Role

	Spokes		Hub and Spoke		Hub	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Total Reported Consults and Sessions/Month						
8 or fewer	34	50.0	20	44.4	16	36.4
9 through 16	17	25.0	6	13.3	12	27.3
17 through 24	4	5.9	4	8.9	4	9.1
25 through 32	4	5.9	4	8.9	2	4.7
More than 32	8	11.8	10	22.2	9	20.5
Missing	1	1.5	1	2.2	1	2.3
Mean	16.0 sessions/month		36.8 sessions/month		23.6 sessions/month	
Total Reported Clinical Consults/Month[a]						
8 or fewer	42	77.8	10	43.5	16	57.1
9 through 16	5	9.3	2	8.7	5	17.9
17 through 24	1	1.9	2	8.7	1	3.6
25 through 32	2	3.7	2	8.7	0	0.0
More than 32	4	7.4	5	21.7	4	14.3
Missing	0	0.0	2	8.7	2	7.1
Mean	9.8 sessions/month		25.0 sessions/month		18.9 sessions/month	
Total Reported Nonclinical Sessions/Month[a]						
8 or fewer	33	61.1	11	47.8	13	46.4
9 through 16	10	18.5	4	17.4	5	17.9
17 through 24	1	1.9	3	13.0	2	7.1
25 through 32	2	3.7	1	4.3	3	10.7
More than 32	5	9.3	3	13.0	3	10.7
Missing	3	5.6	1	4.3	2	7.1
Mean	9.4 sessions/month		20.0 sessions/month		15.8 sessions/month	

[a] Only the mail respondents reported volume by type: clinical or nonclinical.

The scope of a telemedicine facility's activities appears to be related to utilization (see exhibit 3.3.13). Facilities just starting operations were much more likely to report low utilization; 60 percent reported the system was used eight or fewer times in a month. Systems that had been used for four or more types of specialties reported a higher volume: 35 percent reported that the system was used more than once a day. The association between the scope of the system and volume is also seen when the sample is restricted to only mail respondents and clinical consults are separated from nonclinical sessions.

Exhibit 3.3.13
The Variation of Volume by Scope of System

	Start-Up[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Total Reported Consults and Sessions/Month						
8 or fewer	34	60.0	20	48.8	13	30.2
9 through 16	15	23.1	11	26.8	9	20.9
17 through 24	6	9.2	4	9.8	1	2.3
25 through 32	3	4.6	3	7.3	3	7.0
More than 32	5	7.7	5	12.2	15	34.9
Missing	2	3.1	0	0.0	1	2.3
Mean	13.3 sessions/month		17.1 sessions/month		36.2 sessions/month	
Total Reported Clinical Consults/Month[b]						
8 or fewer	35	74.5	18	60.0	14	58.3
9 through 16	4	8.5	5	16.7	2	8.3
17 through 24	2	4.3	1	3.3	1	4.2
25 through 32	1	2.1	2	6.7	1	4.2
More than 32	3	6.4	3	10.0	6	25.0
Missing	2	4.3	1	3.3	0	0.0
Mean	9.5 sessions/month		11.2 sessions/month		28.0 sessions/month	
Total Reported Nonclinical Sessions/Month[b]						
8 or fewer	32	68.1	13	43.3	10	41.7
9 through 16	7	14.9	9	30.0	3	12.5
17 through 24	4	8.5	0	0.0	2	8.3
25 through 32	2	4.3	3	10.0	1	4.2
More than 32	0	0.0	2	6.7	8	33.3
Missing	3	6.4	3	10.0	0	0.0
Mean	6.9 sessions/month		12.0 sessions/month		27.4 sessions/month	

[a] Start-ups have only been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities   using the system in four or more clinical areas are defined as having a broad application base.
[b] Only the mail respondents reported volume by type: clinical or nonclinical

Estimates of facility level volume should be treated with caution because respondents may not have interpreted our questions about volume in consistent ways. A clinical consult is typically a single encounter between specialist and patient. However, some programs schedule speciality teleclinics where a consultant sees several patients during one connection. This could have been be counted as one session or as several.[11]

Low volume estimates are matched by reports that few clinicians had used the telemedicine system.[12] Exhibit 3.3.14 presents the total number of physicians and the percentage of all clinicians, by type, who had used the system, across the different types of facilities. Although the absolute number of those who had used the system was low, these figures represent a fairly high percentage of all potential users. One-third of spokes answering the mail survey reported that three or more primary care physicians had used their systems and 28 percent indicated that all primary physicians at the facility had used telemedicine at least once.

Correlates of Volume

A statistical analysis was conducted to explore the factors associated with variation in telemedicine usage. For this work only hospital facilities with telemedicine services were used, excluding teleradiology sites and nonhospital sites.

Regression techniques were employed to test hypotheses about the influences of several programmatic and facility variables on number of telemedicine sessions during a two-month period. Regression models were developed for volumes of clinical services and for volumes of total sessions (clinical and nonclinical sessions combined). The descriptive work reported earlier and the site visits conducted as part of the project (see chapter 4.0) suggested that session volume would be higher in more mature telemedicine systems and at facilities in more isolated places. Covariates also included variables to control for size of institution, size of telemedicine network, type of site (hub, spoke) and type of technology available (IATV, email, desktop).

The variables used in the regression and their means are shown in exhibit 3.3.15. The variables included were:

1. log of staffed beds
2. log of months since facilities telemedicine system became operational
3. number of facilities in the telemedicine network
4. Dummy (0,1) variable indicating hub site, or not
5. Dummy variable indicating spoke site

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[11]   This distinction is particularly problematic when it is noted that the mail survey asked for counts of patient consults and nonpatient care sessions, but the phone survey asked for a count of telemedicine sessions. It was noted in a prior study that reported volume among phone respondents was frequently less than those of mail respondents.

[12]   Hubs were not asked these questions.

Exhibit 3.3.14
Number and Percentage of Clinicians by Type Using the Telemedicine System
By Role in Network

	Spokes		Hub/Spoke	
	Number	Percent	Number	Percent
Total	54	100.0	23	100.0
Number of Clinicians Using System				
Primary Physicians				
None	6	11.1	5	21.7
1 to 2	23	42.6	8	34.8
3 or more	18	33.3	5	21.7
Missing	7	13.0	5	21.7
Specialists Physicians				
None	17	31.5	6	26.1
1 to 2	6	11.1	5	21.7
3 or more	6	11.1	9	39.1
Missing	25	46.3	3	13.0
Other Clinicians[a]				
None	13	24.1	6	26.1
1 to 2	19	35.2	3	13.0
3 or more	7	13.0	8	34.8
Missing	15	27.8	6	26.1
Percent of All Clinicians using System				
Primary Physicians				
None	5	9.3	5	21.7
20% or less	9	16.7	4	17.4
21 through 50%	8	14.8	4	17.4
51 through 99%	7	13.0	1	4.3
100%	15	27.8	4	17.4
Missing	10	18.5	5	21.7
Specialists Physicians				
None	12	22.2	5	21.7
20% or less	2	3.7	8	34.8
21 through 50%	5	9.3	3	13.0
51 through 99%	0	0.0	2	8.7
100%	5	9.3	1	4.3
Missing	30	55.6	4	17.4
Other Clinicians[a]				
None	10	18.5	6	26.1
20% or less	2	3.7	3	13.0
21 through 50%	5	9.3	5	21.7
51 through 99%	1	1.9	0	0.0
100%	14	25.9	3	13.0
Missing	21	38.9	6	26.1

[a] Includes physician assistants, nurse practitioners, nurse midwives, mental health practitioners, and an "other" category.

Exhibit 3.3.15
Regression Results

Variable	All Sessions Model		Clinical Session Model	
	Coefficient	p	Coefficient	p
Intercept *	-.825	.327	-.476	.730
Log Staffed Beds *	.208	.154	.078	.742
Log Age in Months *	.543	.003	.677	.025
IATV *	.130	.654	-.442	.331
Desktop *	-.314	.414	-.459	.448
E-Mail *	.241	.449	.480	.330
Spoke *	-.104	.733	-.812	.107
Hub *	.240	.495	.129	.834
Number Facilities in Network *	.022	.081	.013	.492
Location in Clinical Area *	.288	.400	.200	.719
Medicaid Pays *	.098	.765	-.135	.754
Federal Grant *	.835	.004	.570	.173
Store & Forward *	.048	.862	.878	.034

*   Means of all variables are available in appendix A4.

6.   Dummy variable indicating if TM unit(s) located in clinical area of the facility, or not
7.   Dummy variable indicating if facility equipped with studio IATV, or not
8.   Dummy variable indicating if facility equipped with desktop IATV, or not
9.   Dummy variable indicating if facility equipped with store-and-forward technology, or not
10.   Dummy variable indicating if facility equipped with e-mail, or not
11.   Dummy variable indicating if Medicaid reimbursement is received for TM services, or not
12.   Dummy variable indicating if Federal contract/grant funds have been received, or not.

The model was fit using natural logarithms of most continuous variables. This transformation downweights the importance of extreme values, and makes interpretation of regression coefficients direct; a coefficient of 1.10 is interpreted as a 1.1 percent change in the number of sessions associated with a 1.0 percent change in the independent variable. The results were fairly robust to the alternative specifications. Due to item nonresponse, the "total session" model was fit on only 109 of the 157 telemedicine sites, and the "clinical sessions" model was able to be fit on only 73 observations. Other respondents failed to provide information for each of the variables in the model.

Exhibit 3.3.15 shows the results of the modeling exercise. The first colume of results refers to the model of "total sessions." Here we find significant ($p<.05$) positive associations with volume for:

> **Maturity of the facility's TM program.** Other factors held constant, facilities with 1 percent greater longevity had about 0.36 percent more sessions.

Whether federal grant support was received. Other factors held constant, facilities that successfully negotiated Federal grant or contract support had about 3 percent higher volume of total sessions than those that did not have these successful negotiations.

Correlations for other measures included in the model were not statistically significant. Number of facilities in the network was positively associated with number of sessions and nearly significant (p=.08). Likewise, size of network was nearly significant (p=.15) and positively associated with number of sessions.

Clinical sessions may be more important than total sessions in evaluating the impact of telemedicine. In the clinical usage models, maturity was also a significant positive influence. Size (number of beds and number of facilities in the network) was apparently less influential. Spoke status was associated with fewer clinical sessions, as might be expected. Payment and Federal grant variables were not correlates of clinical session volume. Most interesting are the technology variables. In the all-session model, no particular technology was volume enhancing. In the clinical session model, however, the presence of store-and-forward technology was positively associated with higher volume.

These regression results indicate that program maturity was an important determinant of utilization. Since telemedicine was diffusing rapidly at the time of the survey and the average age of telemedicine programs was quite young, utilization should continue to rise in the industry, helping to reduce unit costs. It also seems that whether Medicaid payment was being received for telemedicine consults did not influence utilization. This suggests that payment was not a significant marginal utilization incentive for installed telemedicine programs, and that lack of reimbursement was not a marginal barrier either. Payment arrangements may still be important to facility adoption decisions, an idea which cannot be tested with these data.

The significance of Federal grant support in the total session model is more of a puzzle. It may be that grant support subsidized the construction or operation of certain volume-enhancing infrastructure, or built/enhanced visibility or credibility in the community or institution, which in turn encouraged higher volume. Or perhaps facilities that applied or were selected for such awards were more likely to have higher session volumes for other reasons, not well controlled by the measures in the regression model. The fact that simpler and possibly more flexible or convenient store-and-forward technology is a clinical volume enhancer is consistent with anecdotal evidence. Unfortunately, the dearth of data make exploration of relationships between utilization technology and network role impossible.

The importance of store-and-forward technology is consistent with anecdotal information, which indicates that clinicians find this technology more convenient and flexible than IATV.

The Scope of Telemedicine

Exhibit 3.3.16 indicates that almost 14 percent of facilities did not report the speciality areas using the system. Because of the question format, these cases can be interpreted as either missing values

Exhibit 3.3.16
The Clinical Scope of Telemedicine Facilities (n = 159)

	Number	Percent
Number of Different Reported Specialty Applications[a]		
None Reported	22	13.8
1 through 3	61	38.4
4 through 6	36	22.6
7 through 9	18	11.3
10 through 12	11	6.9
13 through 18	11	6.9
Mean	4.5 specialties	
Regularly Prescheduled Speciality Clinics	48	30.2
Most Commonly Reported Specialty Applications[b]		
Radiology	82	51.6
Cardiology	69	43.4
Orthopedics	55	34.6
Dermatology	52	32.7
Psychiatry	50	31.4
Number of Different Reported Clinical Functions[c]		
None Reported	21	13.2
1 through 3	62	39.0
4 through 6	43	27.0
7 through 9	25	15.7
10 through 12	8	5.0
Mean	3.8 functions	
Most Commonly Reported Clinical Functions[b]		
Routine Diagnostic Consults	102	64.2
Transmission of Medical Data Only	81	50.9
Management of Chronic Illnesses	66	41.5
Number of Different Reported Nonclinical Uses[d]		
None Reported	20	12.6
1 through 3	47	29.6
4 through 6	55	34.6
7 through 9	26	16.4
10 through 13	11	6.9
Mean	4.4 nonclinical functions	
Most Commonly Reported Nonclinical Uses[b]		
Continuing Education for Health Professionals	121	76.1
Administrative Meetings	108	67.9
Demonstrations to Health Care Personnel	98	61.6

[a] The survey specifically asked about 21 specialty applications; range 0-18 applications.

[b] Due to multiple responses, percentages sum to more than 100 percent.

[c] The survey specifically asked about 12 clinical functions; range 0-12 applications.

[d] The survey specifically asked about 13 nonclinical functions; range 0-13 applications.

or evidence that the system was not being used for specialty clinical care at the time of the survey.[13] Another 38 percent of the sample reported that as few as three clinical specialties had used the system even once, while 48 percent of the sample reported that four or more specialty areas had used their telemedicine systems at least once. Thirty percent of respondents reported that they routinely scheduled specialty teleclinics, an indication that the provision of speciality care via telemedicine was becoming an established component of care at some facilities. The most commonly reported specialty applications were radiology, cardiology, and orthopedics.

The survey also explored the clinical function of a session (e.g., diagnosis, surgical follow-up, management of chronic illness). The most common types of care or clinical functions that had occurred at least once via telemedicine were routine diagnostic consults (64 percent), transmission of medical data (51 percent), and the management of chronic illnesses (42 percent).

Telemedicine systems were also used for nonclinical applications such as continuing education for health professionals (76 percent reported at least one such session), administrative meetings (68 percent), and demonstrations to health care personnel (62 percent). Fifty-eight percent of the sample had used their equipment for four or more different nonclinical uses.

The scope of the system showed only minor variations by the facility's role in the network (see exhibit 3.3.17). Spokes reported the narrowest range of applications. The dual hub/spoke sites had used their systems for greater numbers of applications, but the difference was quite small.

Across all measures, facilities that had been operating for more than one year and that had used their systems for four or more specialties—facilities considered to have broader clinical applications—also appeared to have broad applications in terms of clinical and nonclinical functions (see exhibit 3.3.18). More than 60 percent of these facilities had experience with seven or more specialities using the system. More than half reported prescheduled specialty clinics compared to only 17 percent of facilities with a narrower specialty experience. This broader orientation was also reflected in the number of different clinical functions for which the systems were used: an average of six different functions compared to an average of three for facilities with a narrower range of specialty experience. Broad-based systems also reported the widest range of nonclinical functions: an average of seven different nonclinical functions relative to four among other systems. More than 80 percent of broad-based systems had conducted demonstrations of telemedicine for health care personnel, while only 44 percent of narrow-based systems reported this kind of activity. Demonstrating how the system might be used in clinical practice is likely to be important in promoting the adoption of the technology among clinicians.

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[13] Approximately 36 percent of these cases reported that their system was used for between one and eight different clinical functions. In 17 cases, the facility did not report a date for the starting of patient encounters, which suggests that at the time of the survey the system was not being used for direct patient care.

Exhibit 3.3.17
The Clinical Scope of Telemedicine Facilities
By Role in Network

	Spokes		Hub/Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Number of Different Reported						
Clinical Applications[a]						
None Reported	13	1.1	4	8.9	4	9.1
1 through 3	30	44.1	12	26.7	18	40.9
4 through 6	15	23.5	13	19.1	7	15.9
7 through 9	4	5.9	6	13.3	8	18.2
10 through 12	3	4.4	5	11.1	3	6.8
13 through 18	2	2.9	5	11.1	4	9.1
Mean	3.3 specialties		5.9 specialties		5.1 specialties	
Regularly Prescheduled Speciality Clinics	18	26.5	20	44.4	10	22.7
Most Commonly Reported						
Clinical Applications[b]						
Radiology	31	45.6	23	51.1	27	61.4
Cardiology	26	38.2	23	51.1	20	45.5
Orthopedics	17	25.0	21	46.7	17	38.6
Dermatology	22	32.4	15	33.3	15	34.1
Psychiatry	13	19.1	21	46.7	16	36.4

Exhibit 3.3.17 (continued)
The Clinical Scope of Telemedicine Facilities
By Role in Network

	Spokes		Hub/Spoke		Hubs	
Number of Different Reported Clinical Functions[c]						
None Reported	10	14.7	5	11.1	5	11.4
1 through 3	30	44.1	14	31.1	17	38.6
4 through 6	19	27.9	11	24.4	13	29.5
7 through 9	9	13.2	9	20.0	7	15.9
10 through 12	0	0.0	6	13.3	2	4.5
Mean	3.1 functions		4.9 functions		4.0 functions	
Most Commonly Reported Clinical Functions[b]						
Routine Diagnostic Consults	43	63.2	29	64.4	30	68.2
Transmission of Medical Data Only	31	45.6	28	62.2	21	47.7
Management of Chronic Illnesses	22	32.4	25	55.6	19	43.2
Number of Different Reported Nonclinical Uses[d]						
None Reported	11	16.2	2	4.4	6	13.6
1 through 3	25	36.8	8	17.8	13	29.5
4 through 6	25	36.8	15	33.3	15	34.1
7 through 9	5	7.4	13	28.9	8	18.2
10 through 13	2	2.9	7	15.6	2	4.5
Mean	3.4 nonclinical functions		6.1 nonclinical functions		4.3 nonclinical functions	
Most Commonly Reported Nonclinical Uses[b]						
Continuing Ed. for Health	49	72.1	38	84.4	33	75.0
Professionals	43	63.2	35	77.8	29	65.9
Administrative Meetings	34	50.0	35	77.8	29	65.9
Demos to Health Care Personnel						

[a] The survey asked about 21 clinical applications and allowed for 3 others; range 0-18 reported.

[b] Due to multiple responses, percentages sum to more than 100 percent.

[c] The survey asked about 12 clinical functions and allowed for 3 others; 0-12 reported.

[d] The survey asked about 13 non-clinical functions and allowed for 3 others; range 0-13 reported.

Exhibit 3.3.18
The Clinical Scope of Telemedicine Facilities
By Scope of System

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Number of Different Reported Clinical Applications[b]						
None Reported	11	16.9	8	19.5	0	0.0
1 through 3	26	40.0	33	80.5	0	0.0
4 through 6	16	24.6	0	0.0	16	37.2
7 through 9	6	9.2	0	0.0	12	27.9
10 through 12	3	4.6	0	0.0	8	18.6
13 through 18	3	4.6	0	0.0	7	16.3
Mean	3.9 specialties		1.6 specialties		8.4 specialties	
Regularly Prescheduled Speciality Clinics	16	24.6	7	17.1	23	53.5
Most Commonly Reported Clinical Applications[c]						
Radiology	24	36.9	17	41.5	36	83.7
Cardiology	28	43.1	8	19.5	29	67.4
Orthopedics	23	35.4	4	9.8	26	60.5
Dermatology	21	32.3	3	7.3	26	60.5
Psychiatry	19	29.2	5	12.	23	53.5

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
Number of Different Reported Clinical Functions[d]						
None Reported	11	16.9	6	14.6	0	0.0
1 through 3	28	43.1	22	53.7	10	23.3
4 through 6	16	24.6	10	24.4	16	37.2
7 through 9	8	12.3	3	7.3	11	25.6
10 through 12	2	3.1	0	0.0	8	18.6
Mean	3.3 functions		2.6 functions		6.0 functions	
Most Commonly Reported Clinical Functions[c]						
Routine Diagnostic Consults	38	58.5	21	51.2	38	88.4
Transmission of Medical Data Only	26	40.0	22	53.7	29	67.4
Management of Chronic Illnesses	24	36.9	9	22.0	30	69.8
Number of Different Reported Nonclinical Uses[e]						
None Reported	7	10.8	8	19.5	2	4.7
1 through 3	25	38.5	11	26.8	8	18.6
4 through 6	29	44.6	15	36.6	8	18.6
7 through 9	3	4.6	5	12.2	17	39.5
10 through 13	1	1.5	2	4.9	8	18.6
Mean	3.5 nonclinical functions		3.8 nonclinical functions		6.5 nonclinical functions	
Most Commonly Reported Nonclinical Uses[c]						
Continuing Ed. for Health Professionals	45	69.2	31	75.6	39	90.7
Administrative Meetings	45	69.2	23	56.1	37	86.1
Demos to Health Care Personnel	38	58.5	18	43.9	35	81.4

[a] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating   for more than a year and have used the system for less than four clinical specialities. Facilities using the   system in four more clinical areas are defined as having a broad applications.

[b] The survey asked about 21 clinical applications and allowed for 3 others; range 0-18 applications reported.

[c] Due to multiple responses, percentages sum to more than 100 percent.

[d] The survey asked about 12 clinical functions and allowed for 3 others; range 0-12 applications reported.

[e] The survey asked about 13 nonclinical functions and allowed for 3 others; range 0-13 applications   reported.

The range of specialties using telemedicine is an indicator of the potential of the technologies. The contribution of telemedicine in the provision of specialty care appears across a wide variety of specialties, particularly radiology, dermatology, cardiology, neurology, orthopedics, oncology, and pediatrics (see exhibit 3.3.19). Why these particular specialties more than others? In the case of radiology, this speciality was widely available locally and was also widely accessed via telemedicine. This speciality is well suited to telemedicine technologies and enjoys routine reimbursement of the consulting specialists. Dermatology has been in the forefront of telemedicine development as well, possibly because it is a highly visual field and thus lends itself to telemedicine technologies, requiring only a good-quality still image, not real-time full-motion interactive video. A common cardiology service being accessed is the transmission of EKGs for remote interpretation—a situation similar to radiology in terms of technology and reimbursement (cardiologists are reimbursed for EKG interpretations). Orthopedists rely heavily on transmission of radiographs, and these technologies are well advanced and widely available.

Some specialties where rural unavailability was most acute were not being provided via telemedicine, and the potential for doing so is uncertain. For example, 25 percent of spoke communities did not have an ophthalmologist available, but this specialty had not been accessed remotely by any respondents. Technical limitations may exist in this specialty because the necessary good quality, highly magnified, steady images may be difficult to acquire and transmit via many telemedicine systems (e.g., IATV systems). HIV/AIDS specialists were available locally or through visiting specialists in only 25 percent of spoke communities, but only 3 percent of telemedicine spoke sites had accessed this specialty via telemedicine. One might surmise that the populations served by responding spoke facilities had little need for this expertise or that this type of speciality care, which requires a considerable degree of confidentiality or anonymity, is not well suited to delivery through telemedicine systems. Also, telephone communication may be adequate for many purposes—telemedicine consults may not be required.

Teleradiology was the most commonly reported telemedicine service. As noted earlier, of the 499 respondents in the total sample, 68 percent used only teleradiology; 52 percent of facilities using their systems for clinical applications other than radiology also used their systems for teleradiology. Exhibit 3.3.20 indicates that of the 340 respondents who did only teleradiology, 88 percent used the equipment to transmit CT scans, 80 percent used the equipment to transmitte radiographs, 47 percent used the equipment for nuclear medicine studies, 39 percent used the equipment for MRI studies, and 28 percent used the equipment for excretory urography. Fifteen percent used the equipment for transmitting or receiving mammographic images. (The Food and Drug Administration is concerned about this latter practice if the transmitted radiographs are used for diagnosis. Current research inadequately demonstrates comparable diagnostic quality of transmitted digitized mammography and film mammography. No guidelines have as yet been issued restricting digitization and transmission of mammographic studies).

The most common radiological procedures in telemedicine facilities were radiographs and CT scans, followed by MRI studies and nuclear medicine studies. Among Teleradiology-Only sites, CT scans and radiographs were also the most common.

Exhibit 3.3.19
Specialty Availability In Communities Served by Spoke Facilities (n = 68)

Specialty	Available Locally or Through Visiting Specialists	Have Accessed Via Telemedicine	Available Locally, Through Visits, or Have Used Telemedicine	Percentage Point Gain Via Telemedicine
		Percent		
Cardiology	66.2	38.2	79.4	13.2
Orthopedics	67.6	25.0	72.1	4.5
Dermatology	27.9	32.4	50.0	22.1
General Surgery	89.7	14.7	91.2	1.5
Internal Medicine	75.0	22.1	77.9	2.9
Oncology	48.5	16.2	58.8	10.3
Dentistry	86.8	0.0	86.8	0.0
Pediatrics	51.5	16.2	60.3	8.8
Neurology	38.2	20.6	50.0	11.8
Ophthalmology	76.5	0.0	76.5	0.0
Nuclear Medicine	50.0	0.0	50.0	0.0
Pathology	83.8	7.4	85.3	1.5
Psychiatry	47.1	19.1	54.4	7.3
Radiology	92.6	45.6	97.1	4.5
OB/GYN	72.1	14.7	75.0	2.9
HIV/AIDS	26.5	4.4	29.4	2.9
Social Services	88.2	5.9	89.7	1.5
Therapies (PT, OT)	92.6	5.9	92.6	0.0
Nutrition Services	89.7	2.9	89.7	0.0
Substance Abuse	50.0	2.9	50.0	0.0

Exhibit 3.3.20
Types of Studies Transmitted
by Facilities Using Teleradiology

	Telemedicine Facilities Using Teleradiology		Teleradiology Only Facilities	
	Number	Percent	Number	Percent
Total	109	100.0	340	100.0
Types of Studies Transmitted				
Radiographs	78	71.6	271	79.7
MRI	42	38.5	134	39.4
CT	64	58.7	298	87.7
Angiography	17	15.6	29	8.5
Excretory Urography	12	11.0	96	28.2
Nuclear Medicine	29	26.6	162	47.7
Mammography	17	15.6	52	15.3
Other	17	15.6	159	46.8
Missing	18	16.5	3	0.9

3.4   Cost, Financial Support, and Technology Adoption

In the following sections data are presented regarding costs, billing and reimbursement, and the adoption of different technologies.

3.4.1   Costs and Financing of Telemedicine

<u>Costs</u>

Initial capital costs of telemedicine equipment were substantial (the actual equipment purchased by facilities is described in section 3.4.2). In addition, the incremental costs associated with each use of the system were considerable. Cost data presented here should be interpreted with caution. High item nonresponse rates cause the data to be imprecise and possibly unreliable. These data also show substantial variability; therefore, only distributions of the data are presented rather than summary statistics. The patterns in the data, however, are suggestive of the costs that facilities face.

The data presented in exhibit 3.4.1 suggest that many facilities (67 percent) expended less than half a million dollars to acquire telemedicine equipment (respondents were asked not to include line costs or switches in these figures). Approximately 13 percent spent less than $50,000, while 7 percent spent half a million dollars or more. Facilities incurring the greatest initial costs were hubs and those with broader clinical experiences (see exhibits 3.4.2 and 3.4.3): 14 percent reported initial costs of at least half a million dollars. These costs may represent only the equipment located at the reporting site or include equipment physically located at other facilities in the network or shared within the network. Some spoke facilities may receive their equipment as a loan from their hub partners, which may partially explain the higher item nonresponse rates among spokes for initial costs relative to hubs, 37 percent compared to 11 percent. Newer (start-up) facilities also had a high item nonresponse rate for initial equipment costs, which may reflect loaned equipment from partners or vendors.

In addition to initial equipment costs, each time the connection is made between two points in the network someone must cover the costs of that connection. These costs are represented by respondents' reported annual transmission costs, which can then be distributed across their reported sessions to calculate transmission costs per telemedicine consult or session. Slightly less than 20 percent spent less than $50 per session in transmission costs, while 7 percent spent at least $500 per session. One explanation may be high "connect" charges, regardless of utilization. In the University of North Carolina program, for example, sites paid over $4,000 per month, plus $25 per hour of "air time." In addition, some types of sessions take longer than others. Diagnostic sessions may be lengthier than follow-up sessions, psychiatric sessions may be lengthier than dermatology sessions, etc. Thus some programs may incur higher transmission costs due to the nature of their clinical telemedicine practices.

Exhibit 3.4.1
The Costs of Telemedicine Facilities (n=159)

	Telemedicine		Teleradiology Only	
	Number	Percent	Number	Percent
Total	159	100.0	340	100
Total Initial Cost of All Telemedicine Equipment				
Less than $50,000	20	12.6	144	42.4
$50,000 to $100,000	33	20.8	43	12.6
$100,000 to $500,000	53	33.3	42	12.4
$500,000 or more	11	6.9	6	1.8
Missing	42	26.4	105	30.9
Yearly Transmission Costs Per Consult or Session				
Less than $50	30	18.9	9	2.6
$50 to $200	22	13.8	14	4.1
$200 to $500	12	7.5	17	5.0
$500 or more	11	6.9	72	21.2
Missing	84	52.8	220	64.7
Current Annual Labor Devoted to Telemedicine (FTE)				
Less than 1 FTE	70	44.0	177	52.1
1 to 3 FTEs	35	22.0	46	13.5
3 to 5 FTEs	7	4.4	12	3.5
5 or more FTEs	12	7.5	16	4.7
Missing	35	22.0	89	26.2

Exhibit 3.4.2
The Costs of Telemedicine Facilities
By Role in Network

	Spokes		Hub/Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Initial Cost of Telemedicine Equipment						
Less than $50,000	12	17.6	2	4.4	5	11.4
$50,000 to $100,000	14	20.6	10	22.2	9	20.5
$100,000 to $500,000	15	22.1	18	40.0	19	43.2
$500,000 or more	2	2.9	3	6.7	6	13.6
Missing	25	36.8	12	26.7	5	11.4
Transmission Costs Per Consult/Session						
Less than $50	14	20.6	9	20.0	7	15.9
$50 to $200	8	11.8	7	15.6	7	15.9
$200 to $500	2	2.9	5	11.1	4	9.1
$500 or more	3	4.4	3	6.7	5	11.4
Missing	41	60.3	21	46.7	21	47.7
Annual Labor Devoted to Telemedicine (FTE)						
Less than 1 FTE	37	54.4	16	35.6	15	34.1
1 to 3 FTEs	7	10.3	12	26.7	16	36.4
3 to 5 FTEs	2	2.9	5	11.1	0	0.0
5 or more FTEs	3	4.4	4	8.9	5	11.4
Missing	19	27.9	8	17.8	8	18.2

Exhibit 3.4.3
The Costs of Telemedicine Facilities

By Scope of System

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Initial Cost of Telemedicine Equipment						
Less than $50,000	12	18.5	4	9.8	4	9.3
$50,000 to $100,000	12	18.5	11	26.8	9	20.9
$100,000 to $500,000	19	29.2	13	31.7	18	41.9
$500,000 or more	2	3.1	3	7.3	6	14.0
Missing	20	30.8	10	24.4	6	14.0
Transmission Costs Per Consult/Session						
Less than $50	9	13.8	9	22.0	11	25.6
$50 to $200	12	18.5	4	9.8	5	11.6
$200 to $500	6	9.2	4	9.8	2	4.7
$500 or more	2	3.1	2	4.9	6	14.0
Missing	36	55.4	22	53.7	19	44.2
Annual FTEs Devoted to Telemedicine						
Less than 1 FTE	28	43.1	23	56.1	17	39.5
1 to 3 FTEs	14	21.5	8	19.5	12	27.9
3 to 5 FTEs	2	3.1	0	0.0	5	11.6
5 or more FTEs	4	6.2	2	4.9	4	9.3
Missing	17	26.2	8	19.5	5	11.6

[a] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.

Another measure of cost that relates to telemedicine is staffing: the number of FTEs devoted to coordinating, maintaining and supporting the facility's telemedicine system. Forty-four percent of facilities devoted less than one full time equivalent (FTE) to telemedicine in January 1996, while 12 percent reported dedicating three or more FTEs to telemedicine.

Hubs and facilities with broader clinical experiences reported greater transmission costs (11 to 14 percent reported transmission costs of at least $500 per session) and devoted more labor to telemedicine (11 to 21 percent devote at least three FTEs) than other types of facilities. Spokes and start-ups were the least likely to report transmission cost and FTE information, which may reflect lack of information but may also indicate that costs at these facilities were covered by urban partners or, in the case of transmission costs, subsidized by vendors.

Unit Costs

With high costs and low utilization, the question of unit costs arises. For a rough approximation of unit costs, data were manipulated in the following manner (because high outliers skewed averages, median values were used for unit cost calculations):

1. Median initial equipment investment costs were divided by four (to reflect a straight four-year amortization).

2. Median annual transmission costs were added to the above.

3.   This sum was divided by median number of sessions (monthly sessions x 12).

This calculation produced the estimation of unit costs in exhibits 3.4.4 and 3.4.5. Note that costs for clinician time are not included.

Exhibit 3.4.4
Median Unit Costs (n=159)

	Spokes	Hubs	Dual Hub/Spokes
Median Annual Costs	$40,000	$159,950	$83,174
Median Annual Sessions	84	135	174
Costs Per Session	$476	$1,181	$478

Exhibit 3.4.5
Median Unit Costs For Sites > 1 Year (n=65)

	Spokes	Hubs	Dual Hub/Spokes
Median Annual Costs	$54,500	$178,550	$112,924
Median Annual Sessions	84	174	210
Costs Per Session	$649	$1,026	$538

Sites more than one year old had more costly initial equipment purchases and generally higher annual transmission costs. This may be due to the generation of technology available when they made their purchases. These sites had higher median session volume than younger programs, but the differences were not large enough to outweigh the higher costs (except for hubs whose unit costs were slightly lower among older programs).

Funding Sources and Reimbursement

Facilities had a variety of funding and revenue sources with which to cover their telemedicine costs. Information was collected on funding sources, but not on the relative contribution of each funding source. Exhibit 3.4.6 shows that more than 70 percent of facilities relied on hospital financing mechanisms to cover at least some costs. These mechanisms included direct payment of expenses from the hospital budget and/or bonds or other debt instruments. Hubs and facilities with broader specialty experiences were more likely to indicate this form of financing (see exhibits 3.4.7 and 3.4.8). Approximately 60 percent of facilities had obtained some sort of Federal funding. Vendor and telephone company discounts or in-kind support were mentioned by 46 percent of facilities; dual hub/spoke sites and facilities with broader clinical experiences had been particularly successful at obtaining this kind of funding.

Exhibit 3.4.6
Funding Sources and Reimbursement (n=159)

	Number	Percent
Funding Sources[a]		
Hospital Financing	115	72.3
Federal Contracts/Grants	95	59.8
Vendor Discounts	73	45.9
State Appropriations/Grants	47	29.6
Private Investment	47	29.6
Reimbursement		
Have at Least Negotiated Reimbursement With[a]**:**		
Medicaid	52	32.7
Blue Cross/Blue Shield	47	29.6
Medicare Fiscal Intermediary	42	26.4
Other Private Insurers	21	13.2
HMOs	20	12.6
Successfully Negotiated Reimbursement With[a]**:**		
Medicaid	27	17.0
Blue Cross/Blue Shield	15	9.4
Medicare Fiscal Intermediary	7	4.4
Other Private Insurers	13	8.2
HMOs	12	7.6
Receipt of Reimbursement for Specific Services[b]	80	50.3
Billing		
Requester Bills	36	22.6
Provider Bills	61	38.4
No Bills Submitted	44	27.7
Basis Used for Billing		
Length of Consult	30	18.9
Procedure Code	55	34.6
Complexity of Encounter	24	15.1
Facility Charge	15	9.4
Other	3	1.9
Facility Charges for Nonclinical Use of System	41	25.8

[a] Due to multiple responses, percentages sum to more than 100 percent.

[b] Specific services are: EEGs, EKGs, fetal monitoring, other ultrasounds, radiology, pathology, and clinical consultations.

Only 46 percent of facilities with a narrow base of telemedicine applications (two years old or more, fewer than four types of specialties accessed) had received Federal funding compared to 67 percent of broad-based systems and 63 percent of start-ups. While it is unlikely that the differences between narrow and broad-based facilities are fully explained by Federal funding, this pattern may suggest that systems with broader clinical experiences were successful in obtaining funding from several different sources and in particular, were successful in obtaining Federal funding. The nature of the Federal grants may have played a role as well. ORHP grants, for example, specified multispecialty applications, and those programs able to comply were undoubtedly more successful at obtaining funding from ORHP.

Exhibit 3.4.7
Funding Sources and Reimbursement
By Role in System

	Spokes		Hub/Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Funding Sources[a]						
Hospital Financing	46	67.7	30	66.7	38	86.4
Federal Contracts/Grants	42	61.8	30	66.7	23	52.3
Vendor Discounts	30	44.1	24	53.3	19	43.2
State Appropriations/Grants	19	27.9	16	35.6	12	27.3
Private Investment	17	25.0	17	37.8	12	27.3
Reimbursement						
Have Tried to Negotiate With[a]:						
Medicaid	12	17.6	20	44.4	19	43.2
Blue Cross/Blue Shield	10	14.7	20	44.4	17	38.6
Medicare Fiscal Intermediary	13	19.1	19	42.2	10	14.7
Other Private Insurers	8	11.7	7	15.6	6	13.6
HMOs	8	11.7	19	42.2	10	14.7
Have Successfully Negotiated With:						
Medicaid	6	8.8	11	24.4	10	22.7
Blue Cross/Blue Shield	3	4.4	8	17.8	1	2.3
Medicare Fiscal Intermediary	2	2.9	3	6.7	2	4.5
Other Private Insurers	4	5.9	6	8.8	3	6.8
HMOs	3	4.4	3	6.7	5	11.4
Receipt of Reimbursement[b]	28	41.2	29	64.4	23	52.3
Billing[a]						
Requestor Bills	12	17.6	10	22.2	14	31.8
Provider Bills	19	27.9	16	35.6	26	59.1
No Bills Submitted	18	26.5	14	31.1	12	27.3
Basis Used for Billing						
Length of Consult	6	8.8	16	35.6	8	18.2
Procedure Code	21	30.9	19	42.2	15	34.1
Complexity of Encounter	9	13.2	7	15.6	8	18.2
Facility Charge	8	11.8	4	8.9	3	6.8
Facility Charges for Nonclinical Use of System	16	23.5	19	42.2	6	13.6

[a] Due to multiple responses, percentages sum to more than 100 percent.
[b] Based on a list of services for which the respondent reported at least one received reimbursement.

Exhibit 3.4.8
Funding Sources and Reimbursement
by Scope of System

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Funding Sources[a]						
Hospital Financing	49	75.4	27	65.9	35	81.4
Federal Contracts/Grants	41	63.1	19	46.3	29	67.4
Vendor Discounts	31	47.7	15	36.6	23	53.5
State Appropriations/Grants	16	24.6	9	22.0	17	39.5
Private Investment	20	30.8	5	12.2	18	41.9
Reimbursement						
Have Tried to Negotiated With[b]:						
Medicaid	19	29.2	9	22.0	22	51.2
Blue Cross/Blue Shield	16	24.6	9	22.0	20	46.5
Medicare Fiscal Intermediary	15	23.1	7	17.1	19	44.2
Other Private Insurers	6	9.2	3	7.3	11	25.6
HMOs	9	13.8	5	12.2	6	14.0
Have Successfully Negotiated With[b]:						
Medicaid	11	16.9	13	7.3	11	25.6
Blue Cross/Blue Shield	5	7.7	1	2.4	7	16.3
Medicare Fiscal Intermediary	3	4.6	1	2.4	2	4.7
Other Private Insurers	3	4.6	2	4.9	7	16.3
HMOs	5	7.7	3	7.3	4	9.3
Receipt of Reimbursement[c]	26	40.0	16	39.0	34	79.1
Billing[b]						
Requestor Bills	17	26.2	10	24.4	6	14.0
Provider Bills	11	16.9	16	39.0	30	69.8
No Bills Submitted	24	36.9	10	24.4	7	16.3
Basis Used for Billing						
Length of Consult	11	16.9	6	14.6	11	25.6
Procedure Code	18	27.7	14	34.2	21	48.8
Complexity of Encounter	7	10.8	5	12.2	9	20.9
Facility Charge	4	6.2	5	12.2	4	9.3
Facility Charges for Nonclinical Use of System	13	20.0	8	19.5	17	39.5

[a] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating   for more than a year and have used the system for three or fewer clinical specialities. Facilities using the   system in four or more clinical areas are defined as having a broad clinical application.

[b] Due to multiple responses, percentages sum to more than 100 percent.

[c] Based on a list of services for which the respondent reported at least one service received reimbursement.

Under fee-for-service payment systems, lack of reimbursement may be a barrier to the growth and utilization of telemedicine; this factor was mentioned repeatedly by participants interviewed during site visits (see chapter 4). Fee-for-service providers, especially clinicians, who are unable to receive reimbursement for a telemedicine session may be less likely to fully integrate this technology into their practice. Survey respondents were asked whether they had attempted to negotiate reimbursement with different payers, as well as how successful those negotiations were. The payer most commonly targeted for reimbursement negotiations was Medicaid, mentioned by 33 percent of respondents, but less than one-fifth (17 percent) reported being successful in these negotiations. Even when reimbursement is received, this may cover only the physician's charge/costs, and not any additional costs unique to telemedicine, such as transmission costs. Facility capital costs and transmission costs have not been conclusively dealt with by payers.

The dual hub/spoke hospitals and those with broader clinical experience tended to be the most active in seeking reimbursement; these were also the facilities that reported the highest utilization. More than 40 percent of dual hub/spoke and facilities with broader clinical experiences had negotiated reimbursement with Medicaid, Blue Cross/Blue Shield, and/or the regional Medicare fiscal intermediary. The broader systems were particularly strenuous in negotiating reimbursement with Medicaid (50 percent). Reimbursement negotiations were successful for some: Medicaid reimbursement had been obtained by 24 percent of dual hub/spoke sites and 26 percent of broader-based facilities. Successful negotiations with Medicare were mentioned by 4 percent of respondents. A few of these were involved in waivered Medicare telemedicine demonstrations. It is also possible that Medicare was billed via standard claims and procedure codes, without mention that the interaction was via telemedicine, and respondents reported this as "successful" Medicare negotiations.

Even though many facilities reported that they had not successfully negotiated reimbursement from any given payer, when they were asked to report whether they had been reimbursed for any element in a specific list of telemedicine services, 50 percent reported that for at least one service the facility had received reimbursement.[14] The most commonly reported type of service for which reimbursement had been received was clinical consultations (29 percent). Reimbursement was reported by dual hub/spoke facilities (64 percent) and broader experienced facilities (79 percent). Only 39 percent of facilities using their system for a narrow range of applications had received any type of reimbursement.

Another indication that facilities were pursuing reimbursement, and perhaps receiving it, was whether they submit a bill to payers. Overall, 23 percent of respondents reported that the facility or clinician *requesting* the consultation submits bills, while 38 percent say the facility or clinician *providing* the specialty consultation does so. Procedure codes were the most commonly mentioned billing mechanism (35 percent). More than a quarter, however, reported that no bills were ever submitted for telemedicine sessions. Hub sites were most likely to report that the providing facility or clinician submits bills: 59 percent. Among facilities with broader clinical experience, 70 percent reported that the facility or clinician providing the consultation submits bills. Clearly many of the largest and most active systems were billing; the data do not reveal, however, their success in receiving full or partial payment.

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[14] The list of services included: EEGs, EKGs, fetal monitoring, other ultrasounds, radiology, pathology, clinical consultations, and two places for the respondent to report services not included in the list.

The last revenue source investigated was fees collected for nonclinical uses of the equipment. More than a quarter of responding sites charged users for nonclinical sessions. This revenue source was most prevalent among dual hub/spoke facilities and broader based facilities. The data do not reveal, however, whether these charges fully defrayed the costs associated with nonclinical applications or partially subsidized the costs of clinical applications.

3.4.2   Available Technologies and Equipment

This section explores the different types of technologies and equipment telemedicine facilities had obtained and the extent to which the variability in costs reported above were reflected in the variability of technology and equipment.

Exhibit 3.4.9 shows that the most common transmission technologies involved copper telephone lines (78 percent of Telemedicine facilities and 83 percent of Teleradiology Only facilities) and dedicated telecommunication services such as T1 (76 and 29 percent of Telemedicine and Teleradiology Only facilities, respectively). Fiber-optic lines were also commonly reported (52 percent of Telemedicine facilities) as were switched services such as switched 56 and ISDN. Satellite or microwave transmission are each mentioned by less than 10 percent of respondents. Thirty-eight percent of responding sites reported availability of not only a dedicated service, but also a switched service. The same was true of eight percent of those only using/offering teleradiology services. Detailed information about the reported availability of specific technologies and equipment is available in the appendix.

Exhibits 3.4.10 and 3.4.11 show how the availability of these transmission technologies varied across different types of facilities. Relative to other facilities, dual hub/spoke facilities and start-ups were more likely to report the use of fiber-optic lines. Hubs and start-ups were more likely to have newer switched telecommunication services, while hubs and broader based facilities were more likely to have both dedicated and switched services available. This does not necessarily mean that both were used equally for telemedicine; in some cases, both could be present at the institution but one system mainly used for telemedicine. Earlier exhibits showed that hubs and the broader based facilities were more likely to report substantial initial costs and annual transmission costs; this may reflect the multiplicity of available transmission media.

The majority of telemedicine facilities reported the use of real-time technologies for the transmission of data and images (90 percent). Two-thirds had store-and-forward technologies available, and most had both. While both types of technologies were widely available, facilities using their systems for a broader range of clinical applications were more likely to have either store-and-forward (74 percent) and/or real-time (98 percent) technologies. Respondents who reported IATV systems were asked about the characteristics of these systems. Studio videoconferencing (62 percent), full-motion compressed video (51 percent) and digital transmission (44 percent) were the most commonly reported characteristics. These three characteristics were more likely to be found at facilities with broader clinical experience

Exhibit 3.4.9
Transmission Technology and Equipment Availability (n=159)

	Telemedicine		Teleradiology Only	
	Number	Percent	Number	Percent
Total	159	100.0	340	100.0
Transmission Technology				
Type of Media Used[a]				
Copper Telephone Lines	124	78.0	281	82.7
Fiber-Optic Lines	82	51.6	78	22.9
Other	45	28.3	27	7.9
Telecommunication Services Available[a]				
Switched	77	48.4	76	22.4
Dedicated	120	75.5	99	29.1
Both	61	38.4	26	7.7
Technologies Used[a]				
Store-and-Forward	107	67.3	N/A	N/A
Real-Time	143	89.9	N/A	N/A
Real-Time Videoconferencing[a]				
Studio Videoconferencing	99	62.3		
Full-Motion Compressed Video	81	50.9	N/A	
Digital Transmission	70	44.0		
Studio Videoconferencing with Full-Motion Compressed Video and Digital Transmission	46	28.9		
Types of Peripherals				
None	22	13.8		
1 or 2	56	35.2		
3 or 4	45	28.3		
5 or 6	23	14.5	N/A	
7 or 8	13	8.2		
Mean	2.9 different peripherals			
Most Commonly Reported Peripherals[a]				
Document Camera	103	64.8		
Electronic Stethoscope	76	47.8		
X-Ray Scanner	64	40.3		
			N/A	
Most Common Types of Cameras Available[a]				
Document Camera	96	60.4		
1-chip CCD Camera	65	40.9		
3-chip CCD Camera	58	36.5		

[a] Due to multiple responses, percentages sum to more than 100 percent.

Exhibit 3.4.10
Transmission Technology and Equipment Availability, by Role in Network

	Spokes		Hub/Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Transmission Technology						
Type of Media Used[a]						
Copper Telephone Lines	49	72.1	36	80.0	37	84.1
Fiber-Optic Lines	31	45.6	27	60.0	23	52.3
Other	19	27.9	11	24.4	14	31.8
Telecommunication Services Available[a]						
Switched	25	36.8	22	48.9	28	63.6
Dedicated	50	73.5	38	84.4	31	70.5
Both	17	25.0	20	44.4	23	52.3
Technologies Used[a]						
Store-and-Forward	43	63.2	31	68.9	31	70.5
Real-Time	62	91.2	41	91.1	39	88.6
Real-Time Videoconferencing[a]						
Studio Videoconferencing	41	60.3	28	62.2	29	65.9
Full-Motion Compressed Video	27	39.7	29	64.4	24	54.6
Digital Transmission	25	36.8	23	51.1	21	47.7
Studio Videoconferencing with Full Motion Compressed Video and Digital Transmission	13	19.1	16	35.6	16	36.4
Peripherals						
None	12	17.7	7	15.6	3	6.8
1 or 2	24	35.3	15	33.3	17	38.6
3 or 4	15	22.1	16	35.6	13	29.5
5 or 6	14	20.6	5	11.1	3	6.8
7 or 8	3	4.4	2	4.4	8	18.2
Mean	2.7 peripherals		2.6 peripherals		3.4 peripherals	
Most Commonly Reported Peripherals[a]						
Document Camera	39	57.4	32	71.1	30	68.2
Electronic Stethoscope	36	52.9	19	42.2	20	45.5
X-Ray Scanner	24	35.3	18	40.0	21	47.7
Most Common Types of Cameras Available[a]						
Document Camera	37	54.4	32	71.1	26	59.1
1-chip CCD Camera	24	35.3	18	40.0	22	50.0
3-chip CCD Camera	24	35.3	19	42.2	15	34.1

[a] Due to multiple responses, percentages sum to more than 100 percent.

Exhibit 3.4.11
Transmission Technology and Equipment Availability

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Transmission Technology						
Type of Media Used[b]						
Copper Telephone Lines	47	72.3	32	78.1	37	86.1
Fiber-Optic Lines	36	55.4	18	43.9	22	51.2
Other	16	24.6	11	26.8	15	34.9
Telecommunication Services Available[b]						
Switched	34	52.3	18	43.9	21	48.8
Dedicated	50	76.9	24	58.5	40	93.0
Both	27	41.5	10	24.4	21	48.8
Technologies Used[b]						
Store-and-Forward	46	70.8	24	58.5	32	74.4
Real-Time	60	92.3	33	80.5	42	97.7
Real-Time Videoconferencing[b]						
Studio Videoconferencing	43	66.2	23	56.1	31	72.1
Full-Motion Compressed Video	34	52.3	13	31.7	30	69.8
Digital Transmission	31	47.7	12	29.3	24	55.8
Studio Videoconferencing with Full Motion Compressed Video and Digital Transmission	21	32.3	7	17.1	17	39.5
Peripherals						
None	12	18.5	7	17.1	1	2.3
1 or 2	20	30.8	19	44.2	15	34.9
3 or 4	21	32.3	7	17.1	15	34.9
5 or 6	10	15.4	4	9.8	7	16.3
7 or 8	2	3.1	4	9.8	5	11.6
Mean	2.6 peripherals		2.5 peripherals		3.4 peripherals	
Most Commonly Reported Peripherals[b]						
Document Camera	45	69.2	22	53.7	32	74.4
Electronic Stethoscope	30	46.2	16	39.0	24	55.8
X-Ray Scanner	20	30.8	16	39.0	21	48.8
Most Common Types of Cameras Available[b]						
Document Camera	46	70.8	18	43.9	28	65.1
1-chip CCD Camera	22	33.9	14	34.2	25	58.1
3-chip CCD Camera	21	32.3	10	24.4	23	53.5

[a] Start-ups have been operating for one year or less. Facilities with narrow application have been operating   for more than a year and have used the system for three or fewer clinical specialities. Facilities using the   system in four or more clinical areas are defined as having a broad clinical application.

[b] Due to multiple responses, percentages sum to more than 100 percent.

Teleradiology Only facilities that planned to expand into other telemedicine applications (n = 74) reported that they planned to add full-motion interactive video (65 percent) and store-and-forward still images (77 percent). They intended to use these additional technologies to provide medical speciality consultations (76 percent) and emergency and trauma consultations (68 percent); to facilitate the transmission of EKGs, patient records, and other medical data (64 percent); and for surgical consultations (53 percent).

Peripheral scopes and cameras were commonly reported: 86 percent had at least one peripheral, 23 percent reported five or more, and three was the average.[15] The most common peripherals were a document camera (65 percent), electronic stethoscope (48 percent), and x-ray scanner (40 percent). Facilities with a broad clinical telemedicine experience were the most likely to report the availability of any given peripheral: 98 percent had at least one peripheral and 28 percent had five or more. Twenty-six percent of spokes, some of the smallest facilities in the sample, had five or more peripherals. Since peripherals are mainly intended to be used by the site where the patient is present, this is logical. Only thirty-five percent of spokes reported spending less than $100,000 for their equipment. Spokes that reported less costly systems but numerous peripherals may have benefitted from gifted or loaned equipment.[16]

Respondents were asked to separately report the availability of different types of cameras. Again, the most common type of camera reported was a document camera.[17] Other common cameras were the 1-chip and 3-chip CCD cameras (41 and 37 percent respectively).

Lastly, respondents were asked to report whether they used a laser scanner or view box and digitizing cameras for teleradiology consultations. Overall, 35 facilities used a laser scanner (22 percent), 58 facilities used a view box and digitizing camera (37 percent), 29 reported some other type of equipment (18 percent), and 50 respondents reported that they did not use their telemedicine systems for teleradiology consultations (31 percent).

Some of the more technical aspects of the technology information may be underreported. Because the surveys were generally only answered by one individual, it is likely that some respondents were not able to determine, for example, whether their videoconferencing system used compressed or uncompressed video. When facilities using teleradiology were asked to report the technical specifications of their monitor and digitization system, few were able to do so (see appendix). The survey question may have required reference to owners manuals, which is difficult during a telephone interview and impossible if the owners manuals are maintained at another location (e.g., the hub site).

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[15] The list of peripherals was: endoscope, document camera, electronic stethoscope, otoscope, x-ray scanner, ophthalmoscope, dermascope, microscope, remote monitoring equipment, and two "others."

[16] Spokes, dual hub/spoke, and hub facilities receiving vendor discounts or in-kind support, respectively, have an average of 3.3, 2.8, and 3.7 peripherals.

[17] We note that respondents were asked in two different questions about the availability of a document camera at the facility. In the first question, 65 percent reported the availability of a document camera; for the second question, only 60 percent did so. We do not understand why this reporting discrepancy occurred other than in the first question document camera was the second item in the list, whereas it was the fifth item in the second question.

These data suggest that the majority of telemedicine facilities were well equipped for video interactions and that some had an abundance of equipment. It is unlikely that the variation in technologies and equipment fully explains the variation in reported costs. As previously noted, some of the smallest facilities, which were less likely to report substantial costs, appeared to be as rich in technology as larger facilities that reported greater costs. However, facilities with a narrow application base were not as technology rich as those with broader clinical experience, and these narrow-base systems were less likely to report initial costs in excess of $500,000 and more likely to devote less than one FTE to telemedicine.

The availability of particular technologies or equipment components does not necessarily imply that they are readily accessible when needed or convenient to use.

Exhibit 3.4.12
System Accessibility (n=159)

	Number	Percent
Location of Equipment[a]		
Clinical Setting	120	75.5
Administrative Setting	61	38.4
Telemedicine Studio	56	35.2
Scheduling Protocol[a]		
Centralized Scheduling	106	66.7
De-Centralized Scheduling	69	43.4

[a] Due to multiple responses, percentages sum to more than 100 percent.

Accessibility information pertains to the location and scheduling of the equipment (exhibit 3.4.12). Seventy-six percent of respondents located their telemedicine equipment in clinical areas of the facility—the setting believed to be the most accessible to clinicians.[18] More than two-thirds of facilities maintained equipment in a clinical setting, including 87 percent of the dual-role facilities (see exhibits 3.4.13 and 3.4.14). This does not necessarily imply that clinicians, particularly in large institutions, found the location of the equipment convenient. For example, equipment located in an E.R. would require specialists to leave their office space and go to the E.R. for a teleconsult.

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[18] Clinical settings include: ER or its vicinity, radiology, psychiatry or mental health area, physician office space area, outpatient clinic area, or nursing home.

Exhibit 3.4.13
Accessibility By Role in Network

	Spokes		Hub and Spoke		Hubs	
	Number	Percent	Number	Percent	Number	Percent
Total	68	100.0	45	100.0	44	100.0
Location of Equipment[a]						
Clinical Setting	48	70.6	39	86.7	32	72.7
Administrative Setting	23	33.8	19	42.2	18	40.9
Telemedicine Studio	18	26.5	21	46.7	17	38.6
Scheduling Protocol[a]						
Centralized Scheduling	44	64.7	34	75.6	27	61.4
Decentralized Scheduling	29	42.7	16	35.6	24	54.6

[a] Due to multiple responses, percentages sum to more than 100 percent.

Exhibit 3.4.14
Accessibility By Scope of System

	Start-Ups[a]		Narrow Clinical Application		Broad Clinical Application	
	Number	Percent	Number	Percent	Number	Percent
Total	65	100.0	41	100.0	43	100.0
Location of Equipment[b]						
Clinical Setting	49	75.4	31	75.6	31	72.1
Administrative Setting	23	35.4	19	46.3	15	34.9
Telemedicine Studio	22	33.9	9	22.0	23	53.5
Scheduling Protocol[b]						
Centralized Scheduling	39	60.0	41	65.9	34	79.1
Decentralized Scheduling	33	50.8	17	41.5	16	37.2

[a] Start-ups have been operating for one year or less. Facilities with narrow applications have been operating for more than a year and have used the system for less than four clinical specialities. Facilities using the system in four or more clinical areas are defined as having a broad clinical application.
[b] Due to multiple responses, percentages sum to more than 100 percent.

Locating equipment in a less accessible area such as an administrative setting was less common (only 38 percent did so). The facilities with narrower clinical experience were more likely to report that equipment was located in an administration setting, compared to the broader based systems, 46 percent compared to 35 percent. However, more than 40 percent of facilities providing speciality consultations (the hubs and the dual hub/spoke facilities), located equipment in an administrative

setting, and these facilities were more active and had greater volume of clinical and nonclinical sessions than did spokes.

The other possible setting for telemedicine equipment was a telemedicine studio—a location that may or may not be any more accessible than equipment located in an administrative area of the facility. Approximately 35 percent of the sample used telemedicine studios. Almost 50 percent of the dual hub/spoke sites had a telemedicine studio compared to only 26 percent of spokes and 39 percent of the hubs. Because spokes were small, it is not surprising that they were less likely to make this type of capital expenditure (creating such a studio often involves changes to the physical space, installation of air conditioning and new wiring, lighting, etc). More than half of broad-based facilities had a telemedicine studio compared to only 22 percent of facilities with narrow clinical experiences with telemedicine.

Do telemedicine studios facilitate more expansive clinical experiences with telemedicine? It is possible that equipment located in one clinical setting, such as the radiology department, actually discourages the use by other speciality areas if a general perception exists that the equipment is only available for that department. If true, locating equipment in the general administrative area might be just as accessible as a telemedicine studio, unless the administrative space is otherwise occupied (e.g., staff meetings) when needed. The issue of location may become less important as mobile units and desktop systems become more wide spread.

While a facility may have appropriate and accessible equipment, scheduling its use may be difficult. The time of the patient, physician, and other clinicians that attend the patient must be prescheduled. Most telemedicine facilities used a centralized system of scheduling sessions (67 percent), however, 43 percent reported that a decentralized system was used (see exhibits 3.4.12-3.4.14). In these systems, a central switching or "sign-up" is not required and participants can connect to each other as needed. Dual hub/spoke and broader based facilities were most likely to report the use of a centralized scheduling protocol (76 and 79 percent respectively). Decentralized protocols were most common among hubs (55 percent) and start-up facilities (51 percent) and least common at dual hub/spoke (36 percent) and broad-based facilities (37 percent).

Exhibit 3.4.15 shows that 74 percent of spokes and dual hub/spoke facilities had the patient *and* the physician at their facility present during telemedicine consultations. The more people who attend a teleconsult, the more difficult the prescheduling. During site visits, site coordinators reported upwards of eight phone calls and often as many as fifteen being necessary to schedule all the participants in a teleconsultation. This scheduling burden, and the minimal staff available at many facilities to accomplish the scheduling, could be a significant barrier to expanding teleconsulting.

Exhibit 3.4.15
Telemedicine Participants During a Requested Consultation,
at Spokes and Hub/Spoke Sites

	Number	Percent
Total	113	100.0
Individuals Attending Tele-		
consults at the Patient's Facility[a]:		
Patient and Physician	83	73.5
Patient and Other Clinician	43	38.1
Physician Only	62	54.9
Other Clinician Only	18	15.9
Data Transmission		
Followed by Phone Consult	47	41.6

[a] Due to multiple responses, percentages sum to more than
100 percent.

3.5   Data Collection Forms

Respondents were asked to supply the forms they used for collecting patient data, for obtaining informed consent, and for evaluating their programs. The goal was to determine the existing data collection that could contribute to future evaluations.

Patient consent forms were received from respondents in six states. All of the forms included patient authorization for video/filming/photos and the release of information (diagnosis, medical history etc.). The patient was generally instructed that a live transmission would be taking place and asked for written consent to this mode of interaction with a care provider. All of the forms but one included a statement that the video/film/photos could be used for education, information, and teaching purposes.

Patient and physician satisfaction forms were the most common evaluation tools. Patient satisfaction forms were received from respondents in eight states. The majority addressed the patient's willingness to use telemedicine again, preferences (telemedicine or in-person), comfort level, overall satisfaction, and privacy.

Data about the value added by telemedicine (e.g., faster specialty care, less travel), or what would have happened in the absence of telemedicine, were rarely collected by these programs. The evaluation forms in use could be more accurately be described as acceptability surveys since they focus almost entirely on whether users readily accept teleconsultation.

Forms to be filled out by the requesting or originating primary care physician were received from respondents in five states. Items frequently included satisfaction, communication, feelings about using the equipment, and confidence in the diagnosis. Like the patient forms, the physician forms concentrate on acceptability of the technology rather than the value added by the use of telemedicine or whether and how the patient would have obtained care in the absence of telemedicine. Again, these could be considered acceptability surveys.

Forms to be filled out by the teleconsulting specialist were submitted by respondents from three states. All addressed the consultant's confidence in the treatment of the patient, the functioning of the equipment, and preferences about in-person vs. remote consultation. Two addressed satisfaction with telemedicine. One focused entirely on the technology and the functioning of the equipment. Again, there were no questions about what would have happened in the absence of telemedicine, or what value the telemedicine encounter added in the overall course of care for the patient.

In summary, evaluation efforts demonstrated through data collection forms—at least for the programs that responded fully to survey requests—focused on acceptability: whether patients and doctors were comfortable with and had confidence in the technology. Based on the forms reviewed, it is not possible for these programs to evaluate clinical efficacy, nor will their evaluations be able to address the value added by telemedicine, even on rudimentary measures such as avoiding travel to/by health care providers.

3.6   Conclusions From Follow-Up Survey

Despite the paucity of previous research, the first national in-depth survey of telemedicine and teleradiology successfully gathered important and useful data on this emerging technological innovation:

- Telemedicine as an expanding innovation is reflected in the immaturity of most systems. Most facilities had adopted telemedicine technologies only within the last two or three years. Despite this overall immaturity, telemedicine networks were relatively large (an average of 9.3 facilities) and complex with numerous spokes and several dual hub/spoke and hub facilities; most reported that their networks planned to add several more facilities within the next 12 months.

- The average telemedicine facility used its systems no more than 24 times a month, or less than once a day, for clinical and nonclinical uses combined. The data suggest that as a facility matures and broadens its clinical uses of telemedicine, volume increases. Clinical applications of telemedicine were most common in the specialties of radiology and cardiology, and most commonly involved a routine diagnostic consult or transmission of medical data. The most significant contributions to filling specialty availability "gaps" in spoke facilities' communities were in radiology, dermatology, cardiology, neurology, orthopedics, oncology, and pediatrics.

- Telemedicine equipment was costly to acquire and to operate. Facilities covered these costs in several different ways — direct funding from Federal and State grants, hospital support or general revenues, and reimbursement from third party payers.

- Telemedicine facilities appeared to be well equipped with a variety of telecommunication capabilities, technologies, and equipment. It is unlikely that the low utilization reported by these facilities was due to the lack of capacity.

The reported low utilization, clinical and nonclinical, in the face of abundant equipment and substantial financial commitment, is puzzling. Certainly the installed base of equipment could be supporting considerably more activity. Plans to expand by adding new facilities to networks are also somewhat puzzling, given the very low volume of sessions being undertaken at the sites that are already operational.

The reasons for the mismatch between capacity and utilization may be due to the very small size and small population base of some of the rural hospitals installing telemedicine. There may also be barriers faced by hospitals introducing this health care delivery mechanism into established clinical practice. Project staff conducted a series of site visits (see chapter 4.0) to explore these issues in greater detail than is possible via survey.

4.0   Site Visits

In addition to the national surveys discussed in chapters 2 and 3, four intensive site visits were made to rural telemedicine programs. The purpose of these site visits was not to evaluate the programs themselves, but to explore issues that are not amenable to survey data collection, and which are critical to the development, success, and sustainability of telemedicine programs.

4.1   Process

Potential telemedicine networks were identified by assembling survey data and ORHP grantee information.   The criteria used to select the four programs for investigation included:

> Selecting a range of programs, both new and mature, that have different foci, use different equipment and transmission mechanisms, have different administrative structures and different types of participating facilities, and are testing different clinical applications.

> Avoiding networks with only prisons for spokes; at least two spoke sites must be in nonprison settings. A prison telemedicine demonstration is being evaluated; the lessons learned at a prison-only program would not be particularly helpful for this national evaluation of rural telemedicine.

> Avoiding networks that use only teleradiology and networks that have been providing patient care for less than six months. New programs go through a rather steep "learning curve" before settling into any established routines. Observing the early and perhaps chaotic start-up phase was not expected to be as useful as observing somewhat more mature programs (e.g., 6 months or older). ORHP also expressed less interest in the teleradiology programs; they were considered a minor emphasis of this study and we did not wish to devote one of only four site visits to such a program.

> Avoiding networks that have been intensively studied in the past (e.g., Georgia, West Virginia), although programs were selected from among both new programs and those that are more mature. The handful of networks that have been intensively and repeatedly studied, while interesting, are not necessarily representative of the rural telemedicine environment. The purpose was not to chronicle the maturational process of a few pioneer networks, but was to visit sites that have not been the subject of other researchers' investigations in the past.

The survey data were examined to identify new programs that had not been studied in the past and were not among ORHP-funded programs. Only three such programs were identified; all the others were well known to ORHP staff and most had at least some ORHP funding now or at some time in the past. These three programs were contacted; two had used their systems only for educational and administrative purposes and had not yet conducted their first teleconsult. The third had used teleradiology applications in the past and, with Federal funds, was about to implement IATV. ORHP determined that this program was too new to warrant a site visit. The four programs for site visits were selected from ORHP-funded sites, as follows:

- The Rural Health Alliance/Allina program in Minnesota. Selected because of the very active involvement of an integrated delivery system owned by a managed care company.

- The University of North Carolina at Chapel Hill. Selected because it focuses on an interdisciplinary approach to care of elderly rural residents, and because it uses broadcast-quality, wide-screen video over a statewide ATM-switched fiber-optic backbone.

- The Deaconess/Billings clinic in Montana. Selected because it is a mature program, having provided over 200 patient consults, and because it spans a very large, underserved geographic area of a sparsely settled state.

- The University of Kentucky. Selected because it is newer than the other three and brought several sites "up" simultaneously; it allowed observation of a fairly early phase of program implementation.

Two project staff members visited each program for 3-5 days (6-10 person-days/site). Site visit staff included two economists, two health services researchers, a cultural anthropologist, and a clinical psychologist/health services researcher. The questions to be investigated included:

Why was telemedicine implemented in each location? What were the problems it was intended to address, what changes in service delivery or outcomes were anticipated, what cost savings (if any) were anticipated?

How was the present configuration of technologies and specialists selected? What alternatives were considered and why were they rejected? What roles did vendors, consultants, telephone companies or others play in configuring the networks? What design/ decision role did the hub site play? The spoke sites?

Which programs are the most successful in terms of volume (utilization), cost reduction or fulfilling other intended purposes? What are the features of these successful programs and how do they differ from less successful programs? Which are likely to be sustainable after the expiration of Federal funding?

At each site project staff interviewed virtually every type of participant in the telemedicine networks. Table 4.1 indicates the types of people interviewed and the topics discussed with each.

Exhibit 4.1
Topics for On-site Investigation

Topics	Hub Telemed Senior Admin-istrator	Hub Telemed Coord-inators	Hub MDs (Users & Non-Users)	Spoke Telemed Coordin-ators	Spoke Clinicians (Users & Non-Users)	Patients	Others (Payers, telcos, vendors)
Objectives of Telemedicine Program - Primary and Secondary Goals (why was it begun?) - Have these objectives been met? - Where did main motivation originate?	X		X	X	X		X
Barriers to Adoption/Expansion of Telemedicine - Learning curve for practitioners - Acceptability to patients - Convenience/inconvenience for practitioners - Specialist Acceptance/Availability - Integration with existing health system - Threat to existing referral patterns - Insufficient reimbursement/cost	X	X	X	X	X	X	X
Cost Recovery and Sustainability - Source for hardware/software funding - Future sources for same - Agreements with major payers, managed care, prisons, etc. - Charges for CME & nonmedical users - Future prospects for support - Who will decide whether to continue? - What factors will be most important?	X	X		X			X

Relationship between telemedicine and managed care
 - Has managed care increased? Has this
  led to more support/use of telemedicine?
 - Has the availability of telemedicine made
  managed care more feasible?
	X		X	X	X		X

Exhibit 4.1
Topics for On-site Investigation

Topics	Hub Telemed Senior Administrator	Hub Telemed Coordinators	Hub MDs (Users & Non-Users)	Spoke Telemed Coordinators	Spoke Clinicians (Users & Non-Users)	Patients	Others (Payers, telcos, vendors)
Impact of telemedicine on referral/working relationships among providers - More/less choice of specialists - More/less autonomy in selecting specialists - Alterations in established specialist-patient relationships - Alterations in established referral patterns		X	X		X	X	
Comparison of Telemedicine vs. In-Person Consults - Specialist availability and choice, delays - Quality of the interaction/satisfaction - Quality of data acquired telemedically			X		X	X	
Clinical Situations Where Telemedicine is or is Not Appropriate - Cases where telemedicine is adequate - Cases where telemedicine is inadequate - Cases where telemedicine is preferable			X		X		
Utilization - What are the main clinical uses/users? - What are the main nonclinical uses/users? - How often is the system used for teleconsults, CME and medical video-conferencing, admin., nonmedical uses?	X	X	X	X	X		
Technology/Equipment Selections - Who made initial selections and why? - Agreements with telcos/other vendors - Satisfaction with equipment, plans for upgrades - Adequate resolution, gray scales, color - Adequate compatibility & interoperability - In hindsight, would same decisions be made?	X	X	X	X	X		X

Exhibit 4.1
Topics for On-site Investigation

Topics	Hub Telemed Senior Admin-istrator	Hub Telemed Coord-inators	Hub MDs (Users & Non-Users)	Spoke Telemed Coordin-ators	Spoke Clinicians (Users & Non-Users)	Patients	Others (Payers, telcos, vendors)
Technical Support - What training was conducted for Spoke/hub clinicians? - What technical support is available at each site? - How is scheduling of the system handled? - Is telemed. process efficient? - Adequacy of physical environment/location - Integration of data collected telemedically with other components of hospital's information systems	X	X	X	X	X		
Recruitment/retention of rural providers - Is telemedicine a factor in provider decisions to begin rural practice? - Does telemedicine dissuade providers from leaving? - Is CME better with telemedicine (more diverse, more total CME)? - Are grand rounds offered/well attended? - Are rotations/internships now possible with tele-supervision?				X	X		
Clinical Benefits - Are consults accomplished more quickly? - Are follow-up tele-visits more likely to be completed? - Do consults/consultants more appropriately match clinical needs? - Are consultant-specialists more likely to be board certified? - Are patients getting care not otherwise available locally? - Instances of clinical improvement (e.g., blood glucose control or hypertension control)			X	X	X	X	

4.2   Site Visit Conclusions

In brief, conclusions from the site visit investigation are:

Telemedicine programs are implemented to meet a variety of objectives, but little formal needs assessment is conducted prior to implementation. Programs develop according to the desires of clinical "champions" rather than to meet identified clinical needs. Similarly, equipment is often selected before clinical applications are identified and specialists enlisted. These dynamics can lead to mismatches between the directions a program pursues and the needs of the communities it serves.

Administrative and educational videoconferencing are often among the first applications implemented. Exploring clinical applications requires more investment in terms of recruiting specialists, introducing the technology, training clinicians, scheduling teleconsults, and unifying paperwork between consulting facilities.

Patients and primary care practitioners are quite accepting of telemedicine as an alternative health care delivery medium. Specialists have mixed reactions, often relating more to convenience than to clinical acceptability.

The following features of rural telemedicine programs favor sustainability: meeting a critical (and otherwise unmet) need, whether clinical or administrative; having a strong corporate partner or business/competitive motivation; and obtaining reimbursement from several third party payers or finding other ways to compensate providers.

5.0 Recommendations for Future Evaluations

This section explores evaluation concepts and data collection activities for future telemedicine evaluations.

5.1 Evaluation Concepts for Telemedicine Programs

In addition to the use of needs assessments for Continuous Quality Improvement, two concepts are identified for future research: one relating to clinical research and the other relating to health services research.

Clinical Efficacy and Pooled Data

Many physicians are looking for large trials of telemedicine that address questions of clinical efficacy, or at least standards approved by the relevant medical specialty societies (e.g., the American College of Radiology's teleradiology standards). They would feel more comfortable that telemedicine is accepted as "standard" if there were more evidence in the literature.

Most telemedicine programs have not handled enough cases of any one type to be able to draw conclusions about clinical efficacy. In addition, few are collecting data adequate for studies of clinical efficacy; most concentrate on acceptability instead. Few have collected data on comparison cases and few have randomly assigned patients to telemedicine vs. conventional care; there is consequently little published literature on this topic. It seems that the nature of current telemedicine programs will not alter this dynamic very quickly, due to low volume of cases and inadequate data collection plans.

It would be beneficial for programs to collect uniform data in order to pool their experiences for subsequent analyses. It would be most helpful if several programs could establish clinical protocols for this purpose, across a variety of specialties and indications. This may hasten the advancement of definitive efficacy studies, with large enough study populations to be of statistical value. The data collection tools we suggest below are not oriented toward clinical efficacy research. Clinical protocols and data collection instruments will need to be developed for a variety of telemedicine clinical applications to facilitate the necessary multisite research.

Episodes of Care and Value-Added by Telemedicine

In the evaluation plans of the programs we visited and studied via survey, there is little emphasis on evaluating the value added by telemedicine. Evaluation instruments tend to focus on patient and provider acceptance (e.g., was the experience satisfactory, was the equipment adequate, would the participant use telemedicine again). There is little recording of what would have happened in the absence of the teleconsult or the disposition of the consult (resulting treatment orders, referrals, or recommendations). It is not possible to evaluate the number of trips for consultations that are avoided because a teleconsult does not necessarily obviate an in-person consult. It is not possible to evaluate improved quality due to better follow-up, greater continuity of care, more appropriate prescription refills, etc. but it is these kinds of indicators that will "make the case" for telemedicine in the future. Does the teleconsult substitute for an in-person consult? Does it precede an in-person consult? Does it substitute for a follow-up visit? Does it make possible a follow-up visit that would likely otherwise be missed entirely? Does it permit timely refill of prescriptions? As the field matures,

payers, insurers and clinicians will be asking for rigorous research, rather than anecdotes, to address these issues.

Episode-based evaluations would be most appropriate for telemedicine cost-effectiveness evaluations. Managed care and outcomes research is increasingly utilizing episode-based evaluations of the inputs to care of each case, and telemedicine fits this paradigm. Where data permit, reconstruction of entire care episodes will be helpful in identifying exactly what role telemedicine adds to the management of each case. This in turn will make it possible to identify those circumstances where telemedicine does indeed substitute for in-person care, as well as circumstances where telemedicine is an add-on to in-person care. In some of the latter cases, telemedicine may permit better follow-up. In others, telemedicine may add little to patient care other than additional costs.

In the absence of adequate data for episode-based evaluations, much can still be done to improve telemedicine evaluations. At the conclusion of a teleconsult, the consulting specialist or primary care provider (PCP) could indicate the disposition of the case: referral for an in-person consult, telemedicine follow-up, no follow-up needed, etc. The consultant or PCP could also indicate his or her judgment about what would have happened without the teleconsult: patient would have traveled to see a specialist, patient would have waited to see a visiting specialist, patient would have received no care/follow-up, etc. A recommended minimum encounter form for patient-level data includes such items (see below).

5.2 Status of Facility Reporting Capabilities on Telemedicine

Data collection efforts highlight a number of weaknesses in reporting capabilities for evaluations of telemedicine. Survey data is used here to illustrate a number of these concerns, although there is no attempt to provide a thorough analysis of data quality of the two surveys. This section concludes with a discussion of the implications of the indicators of data quality and reporting capability.

The follow-up survey asks some questions about each facility's data capture capabilities. The basic results are provided in exhibit 5.2.1.

Exhibit 5.2.1
Telemedicine Session Data Collection on Site

	Spoke	Hub	Hub/Spoke	Total
% collecting data on sessions at own facility	41%	64%	69%	56%
% with no routine data collection	28%	16%	22%	23%

These data show that only slightly over half of the surveyed sites attempt to collect patient-level information on their telemedicine services. Among those that do not, half suggest that data are collected at a remote facility.

This limitation in data capture is much more acute in spoke facilities than in the hub sites, as would be expected. For the 56 percent of sites that do collect information, the most frequently captured information includes date, data on the physician, and data

Exhibit 5.2.2
Session Data Collected at Responding Facility

Session Item	Spoke	Hub	Hub/Spoke
Consult Date	93%	100%	94%
Duration	64	79	71
Peripherals Used	39	50	58
Reason for Visit	86	86	90
Diagnosis	71	71	87
Name of Physician	93	96	94
Specialty	86	78	90
Demographics	75	79	74

on the diagnosis and reason for visit (see exhibit 5.2.2). All of these measures are reportedly collected by about 9 of every 10 facilities. The least often collected items include duration of visit and peripherals used.

The survey also captured information on whether certain other "special" data collection activities had ever been undertaken, including special surveys or other research investigations. Exhibit 5.2.3 provides these data; only slightly over half of the responding sites reported these sorts of activities.

Although some sites reported participation in studies of satisfaction and benefits, few have collected data from nonparticipating patients or physicians to understand the factors that are impeding participation.

Exhibit 5.2.3
Special Data Collected by Telemedicine Facilities

Item	Spoke	Hub	Hub/Spoke
Patient Satisfaction	43%	48%	69%
Provider Satisfaction	40	64	67
Patients Who Refuse	13	14	24
Providers Who Refuse	12	9	13
Nonclinical Sessions	35	57	64
TM Benefits	42	59	56
Efficacy Data	31	43	49
Health Services Research	16	36	40

Other survey data corroborate the limitations of data gathering efforts among existing telemedicine programs. For example, facilities have difficulty reporting the volume of utilization passing through their telemedicine program.

Utilization information (number of sessions) was solicited in three different ways (total, by specialty, and by clinical function). Exhibit 5.2.4 shows that for those sites able to report (only 40 percent of all sites), there was not a high level of agreement (only about two-thirds) between the volume of sessions reported by specialty with the level reported in the aggregate. And only 69 percent of respondents were able

to report utilization by type of service provided. While utilization information may not be the most important data item, reporting difficulties do suggest the absence of even basic logs of program activity for data capture at telemedicine facilities. In the section below an approach is suggested for a log which could be used to collect data at federally funded projects.

Exhibit 5.2.4
Extent of Utilization Measure Agreement

	Spoke	Hub	Hub/Spoke	Total
Exact agreement in summary and specialty usage measures	72%	67%	47%	65%
Agreement within ± 10%	3	6	13	6
Others	25	27	40	29
TOTAL	100%	100%	100%	100%

Earlier in the report (exhibit 3.2.2), statistics were given on another problem of data capture highlighted by our surveys, item nonresponse, which was high for a number of survey questions. The data show that for a number of items (some quite basic) there is little knowledge of system features among our respondents. To be sure, the survey did not adequately control the nature of the individual respondent, possibly resulting in some respondents only being partially informed. But the problem of nonresponse about basic features of the telemedicine service and technology offerings will continue to hamper policymaking and research activity.

Survey results, taken together, suggest that many telemedicine sites have devoted little attention to collecting data. While this may not be surprising, it limits the ability of researchers and policymakers to conduct research that might help in understanding the proliferation patterns of telemedicine and implementation issues pertaining to rural telemedicine programs.

In the following section it is suggested that, in addition to data collection for each telemedicine encounter (patient-level data), federally-funded sites (and possibly others) could be asked to routinely supply information on facility-level matters using a common reporting structure, such as a survey, on an annual basis.

5.3   Data Collection Recommendations

The problems noted above suggest a limited capability of facilities using telemedicine to report basic information about flow of services, stock of technology, costs and financing, etc. Like every other problem with rapidly diffusing technologies, the absence of standards hampers many other activities. Standards for data collection, instigated by funding sources (i.e., third party payers, grant programs) are limited, and standards regarding characteristics of programs and patient encounters are absent. The lack of uniform data collection standards limits the potential for multiple persons in any site or network to accurately and consistently report these items. As usage of concepts becomes more "standard" (such as has happened with hospital data concepts), this problem will probably resolve. There are a variety of national and international committees working on standards.

While part of the problem results from the absence of expectations and standards about what data to collect, much of the current situation probably results from the fact that telemedicine in rural America

involves institutions that are at the low end of the medical informatics learning curve. Many of these facilities are not sophisticated users of management or clinical information systems. Thus far, the growth in medical informatics has been an urban medical center phenomenon, while the growth in telemedicine has largely been a rural phenomenon. The future growth and dispersion of medical informatics functionality will eventually absorb telemedicine as a particular set of "remote" data capture and data sharing applications, creating an environment where automated data capture will be routine and thorough, and make reporting capabilities universal.

Two kinds of information seem necessary to support research and policymaking pertaining to the adoption of telemedicine in rural America and the scope and volume of utilization of that installed capacity. One type of information relates to "sessions" of telemedicine. The other information relates to the facility providing telemedicine services. The key questions by which research could be supported from the proposed information include:

- What is the level and regional variation in the *capacity* to provide remote populations with specialty care through telemedicine programming?

- What is the *capacity* of the existing systems and what factors about programs, facilities, scope of services, payment, etc., seem to influence the capacity utilization of these programs?

- What kind of technologies and clinical applications are demonstrating the highest utilization rate? What kinds of profiles of use, cost, and financing can be made available to form expectations for the next generation of telemedicine adoptors?

- What features, such as scope of services, location of equipment and type of equipment, seem to be associated with higher (and lower) use?

- Of what influence are trends in technology and utilization on per-unit service costs, on payer adoption of fee-for-service payment rates, and on dependence on non-patient-care revenue?

- What continuing barriers impede telemedicine adoption and diffusion? How do successful programs overcome these barriers?

5.3.1 Session-Level Data Collection

One of the difficulties in collecting information on utilization is the obvious absence of a routine data capture protocol in the facilities surveyed. Although some do have such protocols, they do not routinely collect the same kinds of information. If the Federal Government wants to have routine and comparable data on scope of services and utilization, it must provide some standard of expectations. What follows is a set of data items and definitions which constitute such a standard and could be incorporated into the reporting requirements of grants and contracts.

Exhibit 5.3.1 is a log which could be kept in each facility or at each telemedicine installation within a facility. It captures 10 specific pieces of information on each "session" in which teletechnologies are used. This data capture design could also be represented in the form of a daily schedule log as

well as a data capture log. The data recording activities could be accomplished in a paper encounter form, a scanable encounter form, or an electronic form for accepting keyboard input. All these manual and electronic approaches to implementation of these 10 data items could be done simultaneously, without damaging consistency.

Ten items were selected for inclusion in the log for the minimum data set pertaining to individual sessions. Billing or payer information was not included here, though those items could be added. The date and time information is primarily useful for sites themselves and have little analytic value. Similarly, the duration of the encounter is included to estimate actual "air time" and to permit adaptation to a scheduling tool. The data capture approach for the other seven items makes note of whether the session involves direct patient care. If the care of a particular patient is the object of the session, four items of data are captured, including:

- the type of information problem (seeking, providing, etc.)
- the specialty involved in the service (dermatology, cardiology, etc.)
- the type of service provided (medication check, second opinion, etc.)
- the disposition of the encounter (admit, see specialist in person, etc.).

Within each category, definitions have been classified into numeric codes. These codes relate to the basic direction of information involved in the telecommunication service: whether the site is asking for consultative services or providing them. The log also asks about the professional resources that are present in the location where the patient is.

The specialty codes have been expanded to include more than simply the medical/surgical specialties: therapists, chiropractors, and PA/NP are all added to the list of service providers. The service codes are basically those suggested by Telemedicine Evaluator/Researcher Dr. James Grigsby, though the discharge planning code has been moved into the set of services (from the category of non-patient-care services). Disposition items include appointments, prescriptions, and other items associated with disposition. If teleradiology services are provided, the taxonomy also includes a measure of the type of teleradiology service provided.

Sessions that do not pertain to a particular patient are classified as non-patient-care services. Only one type of service measure (in addition to date, time, and duration) is captured for these sessions.

For both patient-care and nonpatient-care sessions, we suggest capturing the type of equipment used during the session. In most cases, only one type of equipment will be used, but up to three spaces for recording equipment usage should be provided.

Exhibit 5.3.1
Sample Telemedicine Logbook

Date	Time	Duration (min.)	Patient Care Data					Nonpatient-Care Use Code	Equipment Used		
			Purpose of Consult	Specialty	Service	Disposition	Teleradiology				
1/1/97	9:00	15 mins.	3	13	5	5					1
	12:30	90 mins.						9			2
	16:30	15 mins.	5	14	12		1				12
½/97	8:30	30 mins.	2	3	9	2					14

DEFINITIONS OF CODES

Purpose of Consult	Specialty	Service	Disposition	Teleradiology	Non-Patient-Care Use	Equipment/ Session
1. Seeking Consult-Patient & Local Service Provider Present 2. Seeking Consult-Patient & Ancillary Staff Present 3. Seeking Consult-Patient & Family Present 4. Seeking Consult-only local provider present, no patient 5. Seeking Consult-Transmitting Data Only 6. Providing Consult-patient present 7. Providing Consult-only provider present 8. Providing Consult-data received from provider 9. Providing Consult-data from patient's home 10. Other_____	1. Cardiology 2. Orthopedics 3. Dermatology 4. Genl. Surgery 5. Genl. Internal Med. 6. Oncology 7. Dentistry 8. Pediatrics 9. Neurology 10. Ophthalmology 11. Optometry 12. Nuclear Medicine 13. Pathology 14. Psychiatry 15. Radiology 16. OB/GYN 17. HIV/AIDS 18. Midwifery 19. Social Svcs. 20. Therapies (PT, OT) 21. Nutrition Svcs. 22. Substance Abuse	1. Emergency/triage 2. Routine Dx Consult 3. Follow-Up on Medical Treatment 4. Follow-Up on Surgical Treatment 5. Rx Check 6. Discharge Planning 7. Preadmit/Transfer Evaluation 8. E&M for Acute Conditions 9. E&M for Chronic Illness 10. Routine Prenatal Care 11. Therapy Service (OT, PT, ST) 12. Transmit Data Only 13. Supervisory Check 14. Other	1. Admit to hospital 2. In-person visit with specialist 3. In-person visit to local provider 4. Rx written 5. Schedule next TM session 6. No follow-up needed 7. Other	1. Radiographs 2. MRI 3. CT 4. Angiography 5. Urography 6. Nuclear medicine 7. Mammography 8. Other	1. Continuing education for health professionals 2. Supervision of health 3. Clinical conferences/prof. committees 4. Support groups 5. Admin. conferences/ comm. 6. Patient education 7. Elementary/secondary ed. 8. College courses 9. Adult/community education 10. Commercial/non-profit org. 11. Govt. conferences 12. Non-credit in services and demonstrations 13. Other_____	1. Studio/Portable IATV Point to Point 2. Studio/Portable IATV Multipoint 3. Desktop Video Conference 4. Store/Forward 5. Still - 2-way Audio 6. Clips - 2-way Audio 7. Document Camera 8. Microscope 9. Stethoscope 10. Otoscope 11. Endoscope 12. X-Ray Scanner 13. Ophthalmoscope 14. Dermascope 15. Telemetry 16. Other_____

5.3.2   Facility-Level Data Collection

Federal grantees should be able to report investments in technologies, changes in reimbursement, and other basic features of their telemedicine programs on an annual basis using a standard set of definitions. These items were difficult to collect due to the absence of previously developed and tested instruments and inconsistency in locating appropriate knowledgeable respondents at each facility. Like other annual facility data collection activities (e.g., the AHA Annual Survey), there is a need to develop a set of standard definitions and a protocol for response within participating organizations. This can easily be done within the framework of the regular reporting requirements on grants and contracts, or the suggested minimum data set (exhibit 5.3.2) can be collected via survey.

Appendix B is a revised subset of the data collected on the follow-up survey. It contains facility-specific items only—volume estimates and patient-level data would be aggregated from data collected via the log (exhibit 5.3.1).

The 21 items for reporting were adapted from the facility surveys conducted as part of this project. The idea is to be able to monitor—using the results of these tracking data—the nature and size of investments being made by various funding sources, and to provide a standard way of measuring the evolving technology base. As with the session-level data capture definitions, the purpose is to provide a tool that can be used not only for holders of grants and contracts, but for other organizations that may choose to adopt or adapt the tool for easy implementation in their environments (prisons, military, veterans, etc.).

5.4   Conclusion

The data collection tools suggested above are intended to form a consistent, minimum data collection approach that can be implemented across telemedicine programs. The data collected may be useful for many purposes, including each program's own ongoing evaluations and continuous quality improvement efforts.

There remains a need for clinical efficacy studies. The numbers of cases required for such studies, and the need for comparison or control cases probably will require multisite research protocols. Many specialists may hesitate to employ telemedicine in the absence of large, rigorous studies, but such studies will not be possible without the involvement of more specialists and hospitals. The early programs funded with Federal support may be the platform through which such multisite protocols can be implemented. This will require considerable expansion of these programs, the inclusion of academic researchers, and possibly research leadership at the Federal level.

There also remains a need for cost-effective evaluations (CEEs) of telemedicine programs. The field is not yet mature enough for CEEs at most programs, although some may have sufficient volume to begin such evaluations (e.g., Montana's telepsychiatry program). Many participants questioned the cost effectiveness of their own programs, and this concern will amplify when grant support expires and each program is forced to make decisions about continued investment. In addition to each program's need to justify continued investment, there may be a need for a larger, multisite CEE in the future, again to include sufficient numbers of cases for reliable (and generalizable) results.

Appendix A1
Item Nonresponse Rates by
Survey Instrument

		Telemedicine Survey Respondents		Teleradiology Survey Respondents	
		Mail Respondents	Phone Respondents	Mail Respondents	Phone Respondents
Number of Observations		107	52	137	203
		Percent of Nonresponse (missing)			
Facility Characteristics					
Q2	**Facility Type**	0.0	0.0	0.0	0.0
Q3	**Facility AHA ID**	71.0	92.3	73.0	95.6
	Medicare Provider Number	35.5	71.2	41.6	78.3
Q4	**Role in Network (Spoke, Hub, Dual)**	7.5	0.0	N/A	N/A
Q5	**# of Health Professionals[a]**				
	Practicing in Facility	7.6	N/A	N/A	N/A
	Who Have Used Telemedicine	12.7	N/A	N/A	N/A
	Answered Either Section	5.1	N/A	N/A	N/A
Q6	**Distance to Nearest General Hospital[a]**	5.1	2.8	N/A	N/A
Q7	**Specialities Available via[a]**				
	Local Practitioners	3.8	0.0	N/A	N/A
	Visiting Specialists	12.7	13.9	N/A	N/A
	Answered Either Section	0.0	0.0	N/A	N/A
Q8	**Individuals Participating in Sessions[a]**	7.6	5.6	N/A	N/A

Appendix A1
Item Nonresponse Rates by
Survey Instrument

		Telemedicine Survey Respondents		Teleradiology Survey Respondents	
		Mail Respondents	Phone Respondents	Mail Respondents	Phone Respondents
Organization and Implementation					
Q9	Date System Operations Began	3.7	0.0	5.8	2.5
Q4	Date of First Patient Consult	19.5	9.6	16.8	10.3
Q10	Number of Facilities				
	In Your Network	9.3	1.9	N/A	N/A
	Joining Your Network in Next 12 Months	38.3	25.0	N/A	N/A
Q11	Persons Initiating the Telemedicine Program	1.9	0.0	N/A	N/A
Q12	Number of Sessions in Past 2 Months	10.3	3.8	N/A	N/A
Q13	Specialities that Have Used the System	0.0	0.0	N/A	N/A
	Number of Sessions by Specialty	17.8	N/A	N/A	N/A
Q14	Clinical Functions Performed	15.9	7.7	N/A	N/A
	Number of Sessions by Clinical Function	16.8	N/A	N/A	N/A
Q15	Nonclinical Functions Performed	16.8	3.8	N/A	N/A
	Number of Sessions by Nonclinical Function	16.8	N/A	N/A	N/A

Appendix A1
Item Nonresponse Rates by
Survey Instrument

		Telemedicine Survey Respondents		Teleradiology Survey Respondents	
		Mail Respondents	Phone Respondents	Mail Respondents	Phone Respondents
Technologies					
Q16	Technologies Used	5.6	0.0	N/A	N/A
Q17	Peripherals Used	17.8	5.8	N/A	N/A
Q18 Q5	Media Used for Image/Data Transmission	3.7	0.0	3.6	2.5
Q19 Q6	Telecommunication Services Available	14.0	15.4	59.1	54.2
Q20	Characterization of Videoconferencing	15.9	3.8	N/A	N/A
	Percent Answering Not Applicable	5.6	9.6	N/A	N/A
Q21	Cameras Available	16.8	9.6	N/A	N/A
Q22	System Used for Teleradiology	16.8	3.8	9.5	2.0
Q7	Percent Answering Not Used for Teleradiology	24.3	46.2	N/A	N/A
Q23 Q8	Types of Teleradiology Studies Transmitted[b]	19.8	7.1	1.5	0.5
Q24 Q9	Spatial Resolution[b]	49.4	46.4	27.7	50.2
Q25 Q10	Monitor Gray-Scale Contrast[b]	53.1	57.1	25.5	46.8
Q26	Resolution of Digitization System[b]	58.0	53.6	46.7	58.6
Q11					

Appendix A1
Item Nonresponse Rates by
Survey Instrument

		Telemedicine Survey Respondents		Teleradiology Survey Respondents	
		Mail Respondents	Phone Respondents	Mail Respondents	Phone Respondents
Costs and Financing of the System					
Q27	Initial Cost of All Equipment	27.1	25.0	21.2	37.4
Q12	Current Year's Total Transmission Costs	50.5	53.8	55.5	70.9
	Current Annual Labor — FTEs	27.1	11.5	36.5	19.2
Q28	Sources of Funding Since Inception	6.5	1.9	N/A	N/A
Q29	Payer Coverage	21.5	3.8	N/A	N/A
Q30	Services Reimbursed	54.2	40.4	N/A	N/A
Q31	Who Submits the Bill to Insurers	32.7	3.8	N/A	N/A
	Percent not Submitting Bills	22.4	38.5	N/A	N/A
Q32	Basis Used for Charges[c]	45.8	15.6	N/A	N/A
Q33	Charge for Nonclinical Use of System	12.1	7.7	N/A	N/A
Clinical Accessibility					
Q34	Regularly Scheduled Specialty Clinics	9.3	1.9	N/A	N/A
Q35	Physical Location of Equipment	2.8	0.0	N/A	N/A
Q36	Scheduling Procedures	2.8	0.0	N/A	N/A
Confidentiality and Security					
Q37	Data Collected from Sessions	8.4	0.0	N/A	N/A
Q38	Kinds of Patient Information Collected[d]	14.5	5.1	N/A	N/A
Q39	Kinds of General Information Collected	7.5	5.8	N/A	N/A

	Telemedicine Survey Respondents		Teleradiology Survey Respondents	
	Mail Respondents	Phone Respondents	Mail Respondents	Phone Respondents
Expansion Plans of Teleradiology Only Facilities				
Q13 **Plan to Add Other Telemedicine Services**	N/A	N/A	8.8	0.0
Q14 **Services and Technologies that Will be Added**[e]	N/A	N/A	33.3	2.0

N/A = Not Applicable: the question was not included in the survey instrument..

[a] **Question only applicable to spokes and dual-hub-and-spoke sites (those that both receive and give consultations): n = 79 for mail respondents and n = 36 for phone respondents.**
[b] **Question only applicable to Telemedicine facilities offering teleradiology services: n = 81 for mail respondents and n = 28 for phone respondents. All Teleradiology Only facilities were asked to answer this question.**
[c] **Question only applicable to Telemedicine facilities submitting bills to insurers: n = 83 for mail respondents and n = 32 for phone respondents.**
[d] **Question only applicable to Telemedicine facilities that collect patient information: n = 83 for mail respondents and n = 39 for phone respondents.**
[e] **Question only applicable to Teleradiology only facilities that plan to add other telemedicine services: n = 36 for mail respondents and n = 50 for phone respondents.**

	Telemedicine		Teleradiology Only	
	Number	**Percent**	**Number**	**Percent**
Total	**159**	**100.0**	**340**	**100.0**
Type of Media Used[a]				
Copper Telephone Lines	124	78.0	281	82.7
Fiber Optic Lines	82	51.6	78	22.9
Satellite	15	9.4	0	0.0
Microwave	12	7.5	6	1.8
Radio	5	3.1	1	0.3
Co-Axial Cables	33	20.8	27	7.9
Other	0	0.0	19	5.6
Missing	4	2.5	10	2.9
Telecommunication Services Available[a]				
Switched				
Switched 56	46	28.9	38	11.2
ISDN	39	24.5	35	10.3
ATM	14	8.8	10	2.9
Other	1	0.6	9	2.7
Dedicated				
Fractional T1	38	23.9	41	12.1
Full T1 (or multiple T1)	96	60.4	39	11.5
DS-3 or T3 (45 Mbps)	12	7.5	7	2.1
Other	7	4.4	30	8.8
Missing	23	14.5	191	56.2
Data/Image Transfer Systems[a]				
Real Time				
Full-Motion Interactive Video	134	84.3		
Still Images with 2-way Audio	69	43.4		
Video "clips" with 2-way Audio	57	35.8		
Other	12	7.5		
Store and Forward			N/A	
Still Images for Later Review	92	57.9		
Video "clips" for Later Reivew	54	34.0		
Text E-Mail	40	25.2		
Other	9	5.7		
Missing	6	3.8		
Real-Time Videoconferencing[a]				
Studio videoconferencing	99	62.3		
Desktop videoconferencing	24	15.1		
Full-Motion Uncompressed Video	17	10.7		
Full-Motion Compressed Video	81	50.9		
Analog Transmission	31	19.5	N/A	
Digital Transmission	70	44.0		
Not Applicable	11	6.9		
Nonresponse	19	11.9		

Appendix A2
Availability of Technologies and Equipment

	Telemedicine		Teleradiology Only	
	Number	Percent	Number	Percent
Total	**159**	**100.0**	**340**	**100.0**
Peripherals[a]				
Endoscope	23	14.5		
Electronic Stethoscope	76	47.8		
Otoscope	53	33.3		
Ophthalmoscope	36	22.6		
Dermascope	38	23.9		
Microscope	25	15.7	N/A	
X-Ray Scanner	64	40.3		
Document Camera	103	64.8		
Remote Monitoring Equipment	11	6.9		
Other	25	15.7		
Missing	22	13.8		
Types of Cameras Available				
3-chip CCD Camera	58	36.5		
1-chip CCD Camera	65	40.9		
Analog Video Camera	36	22.6		
Digitizing Still Image Camera	33	20.8	N/A	
Document Camera	96	60.4		
Macro Lens	26	16.4		
Camera with Peripheral Scope	52	32.7		
Laser Scanner	19	11.9		
Other	8	5.0		
Missing	23	14.5		

[a] Due to multiple responses, percentages sum to more than 100 percent.

Technical Specification of Monitors and Digitization Systems
Facilities Offering Teleradiology Services

	Telemedicine		Teleradiology Only	
	Number	Percent	Number	Percent
Total	**109**	**100.0**	**340**	**100.0**
Spatial Resolution				
512 512 up to 2048 2048	**17**	**15.6**	**82**	**24.1**
2048 2048 or more	**24**	**22.0**	**59**	**7.4**
Other	**15**	**13.8**	**59**	**17.4**
Missing	**53**	**48.6**	**140**	**41.2**
Gray-Scale Contrast				
256 Shades	**21**	**19.3**	**116**	**34.1**
4096 Shades	**2**	**1.8**	**0**	**0.0**
8 to 32 bit	**27**	**24.8**	**84**	**24.7**
Other	**0**	**0.0**	**10**	**2.9**
Missing	**59**	**54.1**	**130**	**38.2**
Resolution of Digitization System				
512 512	**0**	**0.0**	**4**	**1.2**
1k 1k	**1**	**0.9**	**32**	**9.4**
2k 2k	**37**	**33.9**	**87**	**25.6**
Other	**9**	**8.3**	**33**	**9.7**
Missing	**62**	**56.9**	**183**	**53.8**

	All Session Model	**Clinical Session Model**
Intercept		
Log Staffed Beds	4.50	4.42
Log Age in Months	2.76	2.70
IATV	.66	.68
Desktop	.13	.11
E-Mail	.23	.22
Spoke	.44	.56
Hub	.25	.22
Number Facilities in Network	9.76	9.73
Location in Clinical Area	.18	.15
Medicaid Pays	.81	.73
Federal Grant	.62	.56
Store & Forward	.63	.55
Log Number of Sessions	2.62	1.89
Number of Observations	110	73